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NPL CANDIDATE
Update #
Received SEP 0 3 1987

02NY146

Facility name: St Lawrence - Grasse River System

Location: Grasse and St Lawrence Rivers near Massena in northern Franklin County, New York State

EPA Region: Region 2

Person(s) in charge of the facility: The Grasse River is a New York State Waterway. The St Lawrence River is an International Waterway for the United States and Canada.

Name of Reviewer: Wm. Shaw Date: July 1987

General description of the facility:
(For example: landfill, surface inpoundment, pile, container; types of hazardous substances; location of the facility; contamination route of major concern; type of information needed for rating; agency action, etc.)

The Site is defined as those portions of the Grasse and St Lawrence River System that are contaminated with Polychlorinated Biphenyls and Polynuclear Aromatic Hydrocarbons. The River segments involved stretch from the Massena Power Canal Discharge on the Grasse River (near Massena, NY) downstream to the St Lawrence River, then out to Snell Lock in the St Lawrence and downstream between the shipping channel and the south shore of the St Lawrence River to the Franklin - St Lawrence County Line in New York State. PCB sediment contamination is concentrated near the Alcoa discharge weir, the Reynolds Metals discharge points and the GM Central Foundry treated wastewater discharge, while PAH contamination is found near the Reynolds Metals discharge points. High concentrations of PCB found in fish from this area of the St Lawrence and the nearness of a drinking water supply intake on the St Lawrence indicate that the contamination route of major concern is the Surface Water.

Scores: S_M = 36.69 (S_{gw} = 47.76 S_{sw} = 41.82 S_a = 0)

S_{FE} = 0

S_{DC} = not yet scored

FIGURE 1
MRS COVER SHEET

Grouna Water Route Work Sheet					
Rating Factor	Assigneo value (Circie One)	Multiplier	Score	Max. Score	Ref. (Section)
1 Observed Release	0 45	1	0	45	3.1
If observed release is given a score of 45, proceec to line 4. If observed release is given a score of 0, proceed to line 2.					
2 Route Cnaracteristics					3.2
Oeotn to Aquifer of Concern	0 1 2 3	2	4	6	
Net Precioitation	0 1 3 3	1	2	3	
Permeability of the Unsaturated Zone	0 1 2 3	1	0	3	
Physical State	0 1 2 3	1	3	3	
Total Route Characteristics Score			9	IS	
3 Containment	0 1 2 3	1	3	3	3.3
4 Waste Characteristics					3.4
Toxicity/Persistence	0 3 6 9 12 15 18	1	18	18	
Hazardous Waste Quantity	0 1 2 3 4 5 6 7 3	1	8	8	
Total Waste Characteristics Score			26	26	
5 Targets					3.5
Ground Water Use	0 1 2 3	3	9	9	
Distance to Nearest Well/Population Served	0 4 6 8 10 12 16 18 20 24 30 32 35 40	1	30	40	
Total Targets Score			39	49	
6 If line 1 is 45, multiply 1 x 4 x 5 If line 1 is 0, multiply 2 x 3 x 4 x 5			27378	57,330	
7 Divide line 6 by 57,330 and multiply by 100			S_{gw} = 47.76		

FIGURE 2
GROUND WATER ROUTE WORK SHEET

Surface Water Route Work Sheet					
Rating Factor	**Assigned Value (Circle One)**	**Multi-plier**	**Score**	**Max. Score**	**Ref. (Section)**
1 Observed Release	0 45	1	45	45	4.1
If observed release is given a value of 45, proceed to line 4. If observed release is given a value of 0, proceed to line 2.					
2 Route Characteristics					4.2
Facility Slope and Intervening Terrain	0 1 2 3	1		3	
1-yr. 24-hr. Rainfall	0 1 2 3	1		3	
Distance to Nearest Surface Water	0 1 2 3	2		6	
Physical State	0 1 2 3	1		3	
	Total Route Characteristics Score			15	
3 Containment	0 1 2 3	1		3	4.3
4 Waste Characteristics					4.4
Toxicity/Persistence	0 3 6 9 12 15 18	1	18	18	
Hazardous Waste Quantity	0 1 2 3 4 5 6 7 8	1	8	8	
	Total Waste Characteristics Score		26	26	
5 Targets					4.5
Surface Water Use	0 1 2 3	3	9	9	
Distance to a Sensitive Environment	0 1 2 3	2	6	6	
Population Served/Distance to Water Intake Downstream	0 4 6 8 10 12 16 18 20 24 30 32 35 40	1	8	40	
	Total Targets Score		23	55	
6 If line 4 is 45, multiply 1 x 4 x 5 If line 1 is 0, multiply 2 x 3 x 4 x 5			26910	64,350	
7 Divide line 6 by 64,350 and multiply by 100		S_{sw} =	41.82		

FIGURE 7
SURFACE WATER ROUTE WORK SHEET

Air Route Work Sheet					
Rating Factor	Assigned Value (Circle One)	Multiplier	Score	Max. Score	Ref. (Section)
1 Observed Release	0 45	1	0	45	5.1
Date and Location: No air survey has been conducted					
Sampling Protocol:					
If line 1 is 0, the S_a = 0. Enter on line 5. If line 1 is 45, then proceed to line 2.					
2 Waste Characteristics					5.2
Reactivity and Incompatibility	0 1 2 3	1	0	3	
Toxicity	0 1 2 3	3	9	9	
Hazardous Waste Quantity	0 1 2 3 4 5 6 7 8	1	8	8	
	Total Waste Characteristics Score		17	20	
3 Targets					5.3
Population Within 4-Mile Radius	0 9 12 15 18 21 24 27 30	1	21	30	
Distance to Sensitive Environment	0 1 2 3	2	6	6	
Land Use	0 1 2 3	1	3	3	
	Total Targets Score		30	39	
4 Multiply 1 x 2 x 3			0	35,100	
5 Divide line 4 by 35,100 and multiply by 100			S_a = zero		

FIGURE 9
AIR ROUTE WORK SHEET

	s	s^2
Groundwater Route Score (S_{gw})	47.76	2281.02
Surface Water Route Score (S_{sw})	41.82	1748.91
Air Route Score (S_a)	-0-	-0-
$S_{gw}^2 + S_{sw}^2 + S_a^2$		4029.93
$\sqrt{S_{gw}^2 + S_{sw}^2 + S_a^2}$		63.48
$\sqrt{S_{gw}^2 + S_{sw}^2 + S_a^2} / 1.73 = S_M =$		36.69

FIGURE 10
WORKSHEET FOR COMPUTING S_M

DOCUMENTATION RECORDS
FOR
HAZARD RANKING SYSTEM

SCORING OF THE

FACILITY NAME: St Lawrence - Grasse River System

LOCATION: Grasse and St Lawrence Rivers near Massena in northern Franklin County, New York State

Notes about scoring:

* This scoring package does not consider the impacts of the St Lawrence - Grasse River System on the Canadian Province of Ontario because it is not known how this International situation will be handled in subsequent investigation and remediation negotiations.

* The Hazardous Waste Quantity used in this scoring package is a minimum figure. The figure of 16,204 cubic yards is an estimate for the River sediments in the vicinity of the GM Plant and does not include River sediments with similar concentrations in the vicinity of the Alcoa Plant or the Reynolds Metals Plant.

* There are two aquifers considered in the scoring of the Groundwater Route of this package. They are identified as the Bedrock Aquifer System and the Overburden Aquifer System. The Bedrock Aquifer System (with a score of 47.76) was used in the final evaluation of the Groundwater Route because it represented a greater potential threat than the Overburden Aquifer System (with a score of 43.40).

* The populations using groundwater (from either the Bedrock Aquifer or the Overburden Aquifer) used in the scoring of the Groundwater Route are minimum figures and are based on the information presented in 1962 Groundwater Resources of the Massena - Waddington Area Report (where only selected wells were identified and incorporated).

* Derivation of the population served by groundwater within three miles of the defined site by means of house counting and multiplication by 3.8 would not be accurate in the evaluation of the Groundwater Route score because the particular aquifer (Bedrock or Overburden) used by each household would not be defined. This would lead to an inaccurate score due to the difficulty in determining the aquifer of concern. Therefore only documented uses of particular aquifers were evaluated.

GROUNDWATER ROUTE

1 OBSERVED RELEASE

Contaminants detected (5 maximum):

There is no observed release.

Assigned value of zero.

Rationale for attributing the contaminants to the facility:

There is no observed release.

Assigned value of zero.

* * *

2 ROUTE CHARACTERISTICS

Depth to Aquifer of Concern

Name/Description of aquifer(s) of concern:

Overburden Aquifer System

Principle water bearing zones in the unconsolidated sediments occur within the sand and till materials of the Fort Covington and Malone Drifts. The Fort Covington Drift is composed of marine sand and gravel; marine clay (in part sandy and silty); varved clay with mixed deposits of silt, sand and gravel; and moderately dense and compact till (upper) with mixed and unstratified clay, silt and sand. The Malone Drift is composed of varved clay with interbedded silt, sand and gravel; moderately to very dense and compact till (middle) with mixed and unstratified clay, silt and sand; a second interval of varved clay with interbedded silt, sand and gravel; and a very dense and compact till (lower) with mixed deposits of clay, silt and sand. (The lithologies identified above are described in descending order in the stratigraphic section.) The aquifers in the sand and till materials are generally unconfined and not very extensive. Some confined aquifers with apparently small lateral extents are also present.

Note: For simplicity all aquifers in the unconsolidated sediments are referred to as the Overburden Aquifer System in this scoring report.

Note: This Overburden Aquifer System ranges between 1 foot and 150 feet in thickness with an average thickness of 60 feet.

Bedrock Aquifer System

The upper part of the bedrock in the vicinity of the site forms a single, semi-continuous aquifer which is confined or under artesian conditions in most places. The lithologies encountered within this aquifer include black dolomite (Ogdensburg dolostone); grey dolomite with minor interbeds of limestone, sandstone and shale (Bucks Bridge mixed beds); and locally gypsum beds. Both the Ogdensburg dolomite and the Bucks Bridge mixed beds are units within the Beekmantown Group of Lower Ordovician aged rocks. (The Ogdensburg dolostone overlies the Buck Bridge mixed beds in the stratigraphic section.)

Note: The aquifer is locally called the Ogdensburg Aquifer, but will be referred to as the Bedrock Aquifer System in this scoring report.

Note: The Bedrock Aquifer System described above ranges between 200 and 500 feet in thickness. The system is overlain by the unconsolidated sediments of the Overburden Aquifer System.

(References:

* Draft Remedial Investigation Report for Remedial Investigation / Feasibility Study at the General Motors Corporation - Central Foundry Division - Massena Facility, Massena, NY, prepared by RMT, Inc., May 1986

* Groundwater Resources of the Massena - Waddington Area, St. Lawrence County, New York with Emphasis on the Effect of Lake St. Lawrence on Groundwater, by F.W. Trainer and E.H. Salvas, and prepared by the U.S. Geological Survey in cooperation with the Power Authority of the State of New York and the New York Water Resources Commission, Bulletin GW - 47, 1962

* Waste Site Investigation - Alcoa Massena Operations, submitted by Aluminum Company of America, Massena, NY, prepared by Engineering Science, March 1987)

Depth(s) from the ground surface to the highest seasonal level of the saturated zone (water table(s)) of the aquifer of concern:

Overburden Aquifer System

Minimum known depth is five (5) feet.

(Reference: Draft Remedial Investigation Report for Remedial Investigation / Feasibility Study at the General Motors Corporation - Central Foundry Division - Massena Facility, Massena, NY, prepared by RMT, Inc., May 1986)

Bedrock Aquifer System

Minimum known depth is 59.5 feet at well MW-19 at the GM-CFD in Massena.

(Reference: Draft Remedial Investigation Report for Remedial Investigation / Feasibility Study at the General Motors Corporation - Central Foundry Division - Massena Facility, Massena, NY, prepared by RMT, Inc., May 1986)

Depth from the ground surface to the lowest point of waste disposal/storage:

The true depth to the lowest point of waste disposal/storage is not known, but can be estimated using the "average" river depth at various sampling points within the defined site and assuming that at least one (1) inch of bottom sediment was collected during the sampling. (A sediment thickness of 2.5 feet could be used based on the assumptions incorporated in the calculation of waste quantity and the GM Draft Remedial Investigation Report , however there would be no difference in the value assigned.)

Water depth at sample site #5 on the Grasse River near the Alcoa Plant was approximately 5 feet. Water depth at sample site 04S on the St Lawrence River near the Reynolds Plant was approximately 5 feet. Water depth at sample site 6090107S on the St Lawrence River near the GM-CFD Plant was approximately 6 feet.

After calculation, the "average" water depth plus the "assumed" sediment depth is 5.75 feet. Therefore the depth to lowest point of waste disposal is 5.75 feet.

(References:

* Sediment Sample Data from NYS PCB Sampling of the Grasse and St Lawrence Rivers in the vicinity of Massena, NY, NYSDEC Region 6, 1980 (09/17/80)

* St Lawrence River PCB Sampling Survey near Massena, NY, NYSDEC, 1982 (09/21/82)

* St Lawrence River Sampling in the vicinity of Reynolds Metals, NYSDEC Region 6, 1986 (08/20/86))

The depth to the Aquifer of concern is:

Overburden Aquifer System	Bedrock Aquifer System
5.0' - 5.75' = (-.75')	59.5' - 5.75' = 53.75'

Assigned value of 3 : Assigned value of 2

Net Precipitation

Mean annual or seasonal precipitation (list months for seasonal):

Normal annual total precipitation is 32".

(Reference: Climatic Atlas of the United States, US Department of Commerce, National Climatic Center, Ashville, NC, 1979)

Mean annual or seasonal lake evaporation (list months for seasonal):

Mean annual lake evaporation is 24".

(Reference: Climatic Atlas of the United States, US Department of Commerce, National Climatic Center, Ashville, NC, 1979)

Net precipitation (subtract above figures):

Normal Annual Total Precipitation (32") minus Mean Annual Lake Evaporation (24") equals Net Precipitation (8").

Assigned value of 2.

Permeability of Unsaturated Zone

Soil type in unsaturated zone:

Sand, gravel, silt, moderately dense and compact till, moderately to very dense and compact till, very dense and compact till, and clay (marine and varved).

Note: This applies to both Aquifer Systems.

(References:

* Draft Remedial Investigation Report for Remedial Investigation / Feasibility Study at the General Motors Corporation - Central Foundry Division - Massena Facility, Massena, NY, prepared by RMT, Inc., May 1986

* Groundwater Resources of the Massena - Waddington Area, St. Lawrence County, New York with Emphasis on the Effect of Lake St. Lawrence on Groundwater, by F.W. Trainer and E.H. Salvas, and prepared by the U.S. Geological Survey in cooperation with the Power Authority of the State of New York and the New York Water Resources Commission, Bulletin GW - 47, 1962

* Waste Site Investigation - Alcoa Massena Operations, submitted by Aluminum Company of America, Massena, NY, prepared by Engineering Science, March 1987)

Permeability associated with soil type:

Soil type	Permeability	Value
sand	$>10^{-3}$ cm/sec	3
gravel	$>10^{-3}$ cm/sec	3
silt	10^{-5} to 10^{-7} cm/sec	1
moderately dense/compact till	10^{-5} to 10^{-7} cm/sec	1
moderately to very dense/compact till	$<10^{-7}$ cm/sec	0
very dense/compact till	$<10^{-7}$ cm/sec	0
clay	$<10^{-7}$ cm/sec	0

Assigned value of zero.

Note: This applies to both Aquifer Systems.

(Reference: Uncontrolled Hazardous Waste Site Ranking System A Users Manual (HW-10), Table 2, USEPA, 1984)

Physical State

Physical state of substances at time of disposal (or at present time for generated gases):

PCBs historically released to defined site by the erosion of soils (with adsorbed PCBs) and surface drainage from areas where sludges containing PCBs were stored or disposed of.

Assigned value of 3 (sludge).

(Reference: NYSDEC Region 6, Darrell Sweredoski - Personal Communication, 1987)

* * *

3 CONTAINMENT

Containment

Method(s) of waste or leachate containment evaluated:

The wastes are not stored in a surface impoundment, in containers, in piles or in a landfill. The wastes are mixed with river sediments and found within the water column. There is no liner and the wastes are not stabilized.

(Refer to sediment and surface water sampling data found in:

* Sediment Sample Data from NYS PCB Sampling of the Grasse and St Lawrence Rivers in the vicinity of Massena, NY, NYSDEC Region 6, 1960 (09/17/80)

* St Lawrence River PCB Sampling Survey near Massena, NY,

NYSDEC, 1982 (09/21/82)

* St Lawrence River Sampling in the vicinity of Reynolds Metals, NYSDEC Region 6, 1986 (08/20/86))

Method with highest score:

Based on the above information (no liner and non existent waste stabilization) a value of 3 is assigned for containment.

* * *

4 WASTE CHARACTERISTICS

Toxicity and Persistence

Compound(s) evaluated:

		Toxicity	Persistence	Matrix
	Aroclor 1016/1242	3	3	18
PCB	Aroclor 1254	3	3	18
	Aroclor 1248	3	3	18

(References:

* Sediment Sample Data from NYS PCB Sampling of the Grasse and St Lawrence Rivers in the vicinity of Massena, NY, NYSDEC Region 6, 1980 (09/17/80)

* St Lawrence River PCB Sampling Survey near Massena, NY, NYSDEC, 1982 (09/21/82)

* St Lawrence River Sampling in the vicinity of Reynolds Metals, NYSDEC Region 6, 1986 (08/20/86))

Compound with highest score:

Polychlorinated Biphenyls (PCB) with assigned matrix value of 18.

Hazardous Waste Quantity

Total quantity of hazardous substances at the facility, excluding those with a containment score of 0 (Give a reasonable estimate even if quantity is above maximum):

An estimated 16,204 cubic yards of St Lawrence River sediment having PCB concentrations of at least 50 ppm (considered hazardous waste under TSCA and 6NYCRR 370) is used as a minimum hazardous waste quantity.

A value of 8 is assigned for quantity.

(Reference: Draft Remedial Investigation Report for Remedial Investigation / Feasibility Study at the General Motors

Corporation - Central Foundry Division - Massena Facility, Massena, NY, prepared by RMT, Inc., May 1986)

The quantity of PCBs discharged to the Grasse and St Lawrence Rivers is unknown.

Basis of estimating and/or computing waste quantity:

It is assumed the average thickness of sediments contaminated with > 50 ppm PCB concentration is 2.5 feet. It is also assumed that the area in which concentrations of at least 50 ppm are found extends from the west edge of the bay to 250 feet form shore and to 350 feet downstream from the GM outfall (see Map GW-1). The resulting figure is a rectangle with a long dimension of approximately 700 feet and a short dimension of around 250 feet.

The assumed extent results in 16,204 cubic yards.

(700')(250')(2.5') = 437,500 cubic feet
(437,500 cubic feet)/(27 cubic feet) = 16,204 cubic yards

Note: The average water content of the river sediments is 43%. The dry volume of PCB contaminated soil is 9,236 cubic yards. (16,204 cubic yards)(.57 (soil content)) = 9,236 cubic yards

(Reference: Draft Remedial Investigation Report for Remedial Investigation / Feasibility Study at the General Motors Corporation - Central Foundry Division - Massena Facility, Massena, NY, prepared by RMT, Inc., May 1986)

Note: This is a minimum figure. The figure is an estimate for the River sediments in the vicinity of the GM plant and does not include River sediments with similar concentrations in the vicinity of the Alcoa Plant or the Reynolds Plant.

* * *

5 TARGETS

Groundwater Use

Use(s) of aquifer(s) of concern within a 3-mile radius of the facility:

Overburden Aquifer System

Use(s)	Value
Drinking Water with no municipal water from alternate unthreatened sources presently available	3

See Appendix II

Assigned value of 3.

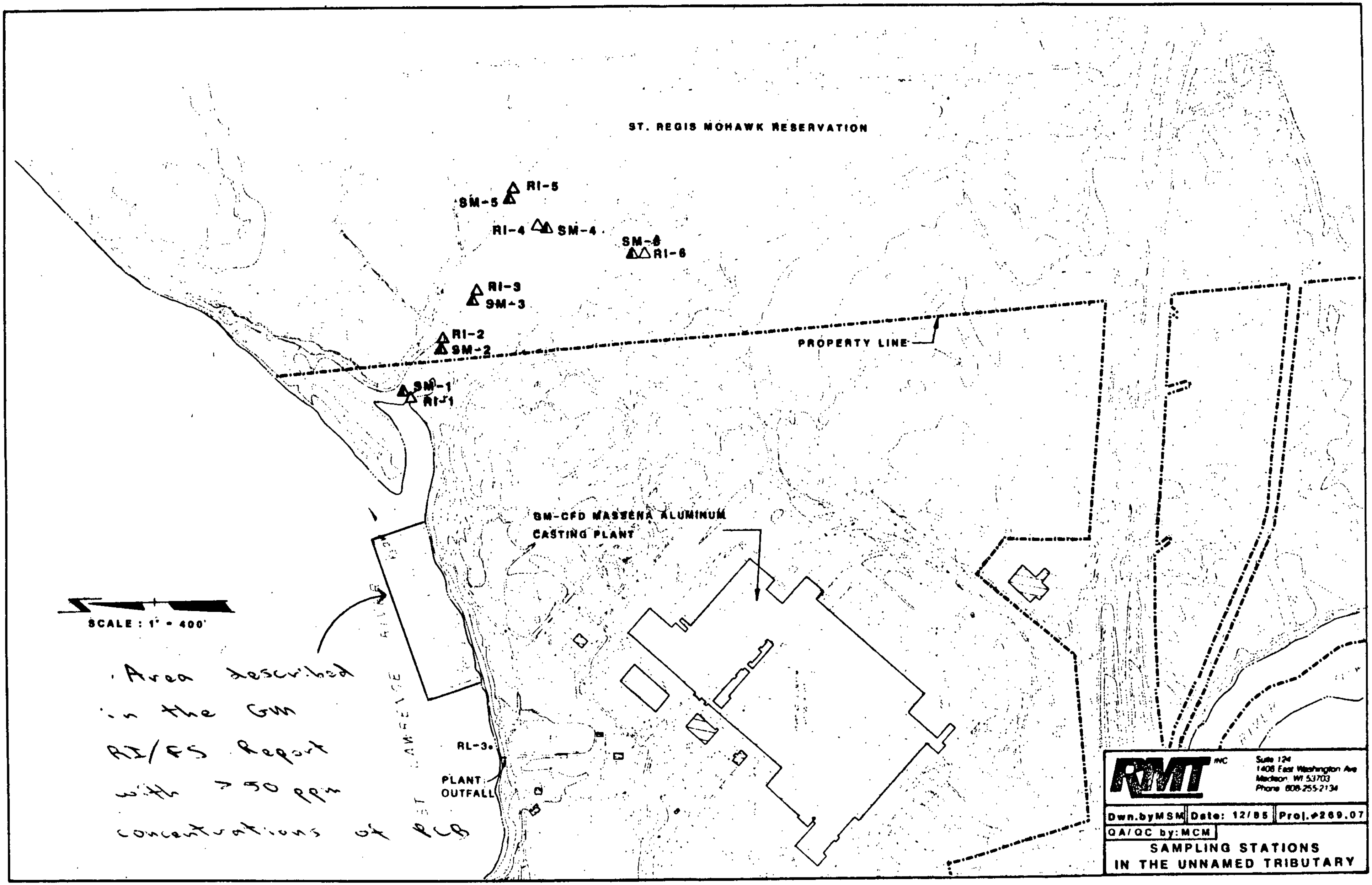


FIGURE 5-4

Map GW-1

(Reference: Groundwater Resources of the Massena - Waddington Area, St. Lawrence County, New York with Emphasis on the Effect of Lake St. Lawrence on Groundwater, by F.W. Trainer and E.H. Salvas, and prepared by the U.S. Geological Survey in cooperation with the Power Authority of the State of New York and the New York Water Resources Commission, Bulletin GW - 47, 1962)

Bedrock Aquifer System

Use(s)	Value
Drinking Water with no municipal water from alternate unthreatened sources presently available......................	3
Commercial and Industrial uses with no alternate unthreatened sources presently available......................	3

See Appendix II

Assigned value of 3.

(References:

* Groundwater Resources of the Massena - Waddington Area, St. Lawrence County, New York with Emphasis on the Effect of Lake St. Lawrence on Groundwater, by F.W. Trainer and E.H. Salvas, and prepared by the U.S. Geological Survey in cooperation with the Power Authority of the State of New York and the New York Water Resources Commission, Bulletin GW - 47, 1962

* New York State Atlas of Water System Sources 1982, published by NYS Department of Health)

Distance to Nearest Well

Location of nearest well drawing from aquifer of concern or occupied building not served by a public water supply:

Overburden Aquifer System

Nearest known well is located on the northern side of the Grasse River in the Hamlet of Massena Center behind the house owned (formerly?) by Albert Alden. The well is about 75 feet from Kinnie Road and about 100 feet from the Grasse River.

Refer to Domestic Well 457-449-8 and see the Overburden Well Location Map in Appendix II.

(Reference: Groundwater Resources of the Massena - Waddington Area, St. Lawrence County, New York with Emphasis on the

Effect of Lake St. Lawrence on Groundwater, by F.W. Trainer and E.H. Salvas, and prepared by the U.S. Geological Survey in cooperation with the Power Authority of the State of New York and the New York Water Resources Commission, Bulletin GW - 47, 1962)

Bedrock Aquifer System

Nearest known well is on the southern side of the Grasse River on property owned (formerly?) by John Lafian. The well is about 120 feet south of the Grasse River and about 500 feet away from South Grasse River Road.

Refer to Domestic Well 457-447-1 and see the Bedrock Well Location Map in Appendix II.

(Reference: Groundwater Resources of the Massena - Waddington Area, St. Lawrence County, New York with Emphasis on the Effect of Lake St. Lawrence on Groundwater, by F.W. Trainer and E.H. Salvas, and prepared by the U.S. Geological Survey in cooperation with the Power Authority of the State of New York and the New York Water Resources Commission, Bulletin GW - 47, 1962)

Distance to above well or building:

The distance to nearest well is:

Overburden Aquifer System	Bedrock Aquifer System
100 feet	120 feet
Assigned value of 4	Assigned value of 4

(Reference: Groundwater Resources of the Massena - Waddington Area, St. Lawrence County, New York with Emphasis on the Effect of Lake St. Lawrence on Groundwater, by F.W. Trainer and E.H. Salvas, and prepared by the U.S. Geological Survey in cooperation with the Power Authority of the State of New York and the New York Water Resources Commission, Bulletin GW - 47, 1962)

Population Served by Goundwater Wells Within a 3-Mile Radius

Identified water-supply well(s) drawing from aquifer(s) of concern within a 3-mile radius and the population served by each:

Overburden Aquifer System

62 known Domestic wells use groundwater from the Overburden Aquifer System within three miles of the defined site and serve 62 households.

Population served = 235.6.

Assume 3.8 people per household.
(62 households)(3.8 people/household) = 235.6 people

See Appendix II and Appendix III.

(Reference: Groundwater Resources of the Massena - Waddington Area, St. Lawrence County, New York with Emphasis on the Effect of Lake St. Lawrence on Groundwater, by F.W. Trainer and E.H. Salvas, and prepared by the U.S. Geological Survey in cooperation with the Power Authority of the State of New York and the New York Water Resources Commission, Bulletin GW - 47, 1962)

Bedrock Aquifer System

91 known Domestic Wells use groundwater from the Bedrock Aquifer System within three miles of the defined site and serve 141 households.

Population served = 535.8.

Assume 3.8 people per household.
(141 households)(3.8 people/household) = 535.8 people

21 known Municipal Wells use groundwater from the Bedrock Aquifer System within three miles of the defined site and serve 91 households plus 125 individuals.

Population served = 470.8.

Assume 3.8 people per household.
(91 households)(3.8 people/household) + 125 = 535.8 people

3 known Wells are assumed to use groundwater from the Bedrock Aquifer System within three miles of the defined site and serve 106 individuals.

Population served = 106.

Total Population Served = 1112.6 people.

535.8 + 470.8 + 106 = 1112.6.

See Appendix II and Appendix III.

(References:

* Groundwater Resources of the Massena - Waddington Area, St. Lawrence County, New York with Emphasis on the Effect of Lake St. Lawrence on Groundwater, by F.W.

Trainer and E.H. Salvas, and prepared by the U.S. Geological Survey in cooperation with the Power Authority of the State of New York and the New York Water Resources Commission, Bulletin GW - 47, 1962

* New York State Atlas of Water System Sources 1962, published by NYS Department of Health)

Computation of land area irrigated by supply well(s) drawing from <u>aquifer(s) of concern</u> within a 3-mile radius and conversion to population (1.S people per acre):

No known land irrigated by above-cited supply wells.

Total population served by groundwater within a 3-mile radius:

Overburden Aquifer System	Bedrock Aquifer System
235.6 people	1112.6 people
See above references and Appendicies II & III	See above references and Appendicies II & III
Assigned value of 2	Assigned value of 2
Matrix Value of 20	Matrix Value of 30

SURFACE WATER ROUTE

1 OBSERVED RELEASE

Contaminants detected in surface water at the facility or downhill from it (5 maximum):

Polychlorinated Biphenyls (PCBs) detected in sediments of the Grasse River, PCBs and Poiynuclear Aromatic Hydrocarbons (PAH or PNA) detected in sediments of the St Lawrence River, and PCBs detected in the water column of the St Lawrence River.

Note 1: PCBs were the primary constituents tested for in the sediment and water studies used to evaluate this score.

Note 2: Mirex was analyzed for in the sediment samples from the Grasse and St Lawrence Rivers in the Region 6 DEC sampling effort of September 1980.

Note 3: PAH and all constituents on the Hazardous Substance List (HSL) were analyzed for in the sediment and water samples from the St Lawrence River in the Region 6 DEC sampling effort of August 1986.

Note 4: Poiynuclear Aromatic Hydrocarbons were not tested for in the sediments from the Grasse River.

Note 5: Sampling information demonstrates the release of:

a) PCBs to the Grasse River Sediments from the Alcoa Plant;

b) PCBs and PAH to the ST Lawrence River Sediments from the Reynolds Metals Plant;

and c) PCBs to the St Lawrence River Sediments from the GM Central Foundry Plant.

Sampling information indicates a release of PCBs to the St Lawrence River Water Column, probably from the Reynolds Metals and GM Plants ... more sampling is needed to confirm.

See Appendix I for complete breakdown.

(References:

* Sediment Sample Data from NYS PCB Sampling of the Grasse and St Lawrence Rivers in the vicinity of Massena, NY, NYSDEC Region 6, 1980 (09/17/80)

* St Lawrence River PCB Sampling Survey near Massena, NY,

NYSDEC, 1982 (09/21/82)

* St Lawrence River Sampling in the vicinity of Reynolds Metals, NYSDEC Region 6, 1986 (08/20/86))

Rationale for attributing the contaminants to the facility:

Sampling information demonstrates the release of contaminants from the Alcoa Plant, the Reynolds Metals Plant, and the GM Central Foundry Plant to the Grasse/St Lawrence River Sediments and indicates a probable release of contaminants from the Reynolds Plant and the GM Plant to the St Lawrence River Water Column.

The breakdown of sampling points and analytical results used to demonstrate the release to the sediments (and presence in the sediments) is presented in Appendix I.

* * *

2 ROUTE CHARACTERISTICS

Facility Slope and Intervening Terrain

Average slope of facility in percent:

Observed Release precludes evaluation of this factor.

Name/description of nearest downslope surface water:

Observed Release precludes evaluation of this factor.

Average slope of terrain between facility and above-cited surface water body in percent:

Observed Release precludes evaluation of this factor.

Is the facility located either totally or partially in surface water?

Observed Release precludes evaluation of this factor.

Is the facility completely surrounded by areas of higher elevation?

Observed Release precludes evaluation of this factor.

1-Year 24-Hour Rainfall in Inches

Observed Release precludes evaluation of this factor.

Distance to Nearest Downslope Surface Water

Observed Release precludes evaluation of this factor.

Physical State of Waste

Observed Release precludes evaluation of this factor.

* * *

3 CONTAINMENT

Containment

Method(s) of waste or leachate containment evaluated:

Observed Release precludes evaluation of this factor.

Method with highest score:

Observed Release precludes evaluation of this factor.

* * *

4 WASTE CHARACTERISTICS

Toxicity and Persistence

Compound(s) evaluated:

		Toxicity	Persistence	Matrix
	Aroclor 1016/1242	3	3	18
PCB	Aroclor 1254	3	3	18
	Aroclor 1248	3	3	18

(References:

* Sediment Sample Data from NYS PCB Sampling of the Grasse and St Lawrence Rivers in the vicinity of Massena, NY, NYSDEC Region 6, 1980 (09/17/80)

* St Lawrence River PCB Sampling Survey near Massena, NY, NYSDEC, 1982 (09/21/82)

* St Lawrence River Sampling in the vicinity of Reynolds Metals, NYSDEC Region 6, 1986 (08/20/86))

Compound with highest score:

Polychlorinated Biphenyls (PCB) with assigned matrix value of 18.

Hazardous Waste Quantity

Total quantity of hazardous substances at the facility, excluding those with a containment score of 0 (Give a reasonable estimate even if quantity is above maximum):

An estimated 16,204 cubic yards of St Lawrence River sediment having PCB concentrations of at least 50 ppm (considered hazardous waste under TSCA and 6NYCRR 370) is used as a minimum hazardous waste quantity.

A value of 8 is assigned for quantity.

(Reference: Draft Remedial Investigation Report for Remedial Investigation / Feasibility Study at the General Motors Corporation - Central Foundry Division - Massena Facility, Massena, NY, prepared by RMT, Inc., May 1986)

The quantity of PCBs discharged to the Grasse and St Lawrence Rivers is unknown.

Basis of estimating and/or computing waste quantity:

It is assumed the average thickness of sediments contaminated with > 50 ppm PCB concentration is 2.5 feet. It is also assumed that the area in which concentrations of at least 50 ppm are found extends from the west edge of the bay to 250 feet form shore and to 350 feet downstream from the GM outfall (see Map SW-1). The resulting figure is a rectangle with a long dimension of approximately 700 feet and a short dimension of around 250 feet.

The assumed extent results in 16,204 cubic yards.

(700')(250')(2.5') = 437,500 cubic feet
(437,500 cubic feet)/(27 cubic feet) = 16,204 cubic yards

Note: The average water content of the river sediments is 43%.
The dry volume of PCB contaminated soil is 9,236 cubic yards.
(16,204 cubic yards)(.57 (soil content)) = 9,236 cubic yards

(Reference: Draft Remedial Investigation Report for Remedial Investigation / Feasibility Study at the General Motors Corporation - Central Foundry Division - Massena Facility, Massena, NY, prepared by RMT, Inc., May 1986)

Note: <u>This is a minimum figure.</u> The figure is an estimate for the River sediments in the vicinity of the GM plant and does <u>not</u> include River sediments with similar concentrations in the vicinity of the Alcoa Plant or the Reynolds Plant.

* * *

5 TARGETS

<u>Surface Water Use</u>

Use(s) of surface water within 3 miles downstream of the hazardous substance:

Economically important resources (Commercial Fisheries)....value 2

Recreation (Recreational Fisheries, Fishing, and Boating)..value 2

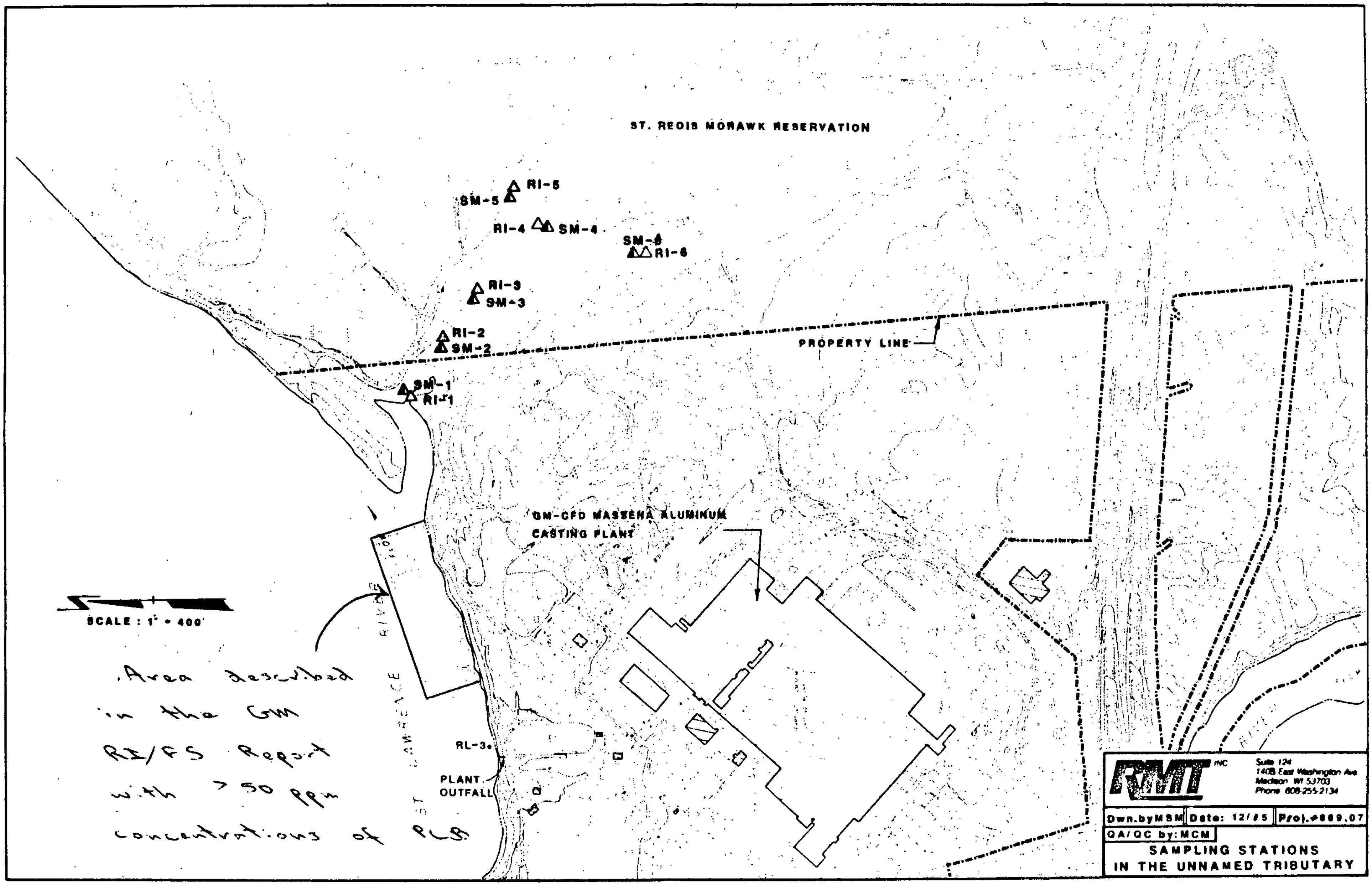


FIGURE 5-4

Map SW-1

Drinking Water (St Regis Mohawk Indian Nation water-supply intake 2.9 miles downstream from the most downstream sampling point showing contamination in excess of New York State Ambient Water Quality Standards for PCB (0.01 ppb) in Class A Surface Waters).............value 3

Assigned value of 3 to surface water use.

(References:

* Draft Remedial Investigation Report for Remedial Investigation / Feasibility Study at the General Motors Corporation - Central Foundry Division - Massena Facility, Massena, NY, prepared by RMT, Inc., May 1986

* New York State Atlas of Water System Sources 1982, published by NYS Department of Health

* NYSDEC Division of Water Technical and Operational Guidance Series Memorandum (85-W-38), Ambient Water Quality Standards and Guidance Values, July 24, 1985

* Planimetric Map of the Hogansburg Quadrangle, NYSDOT, 1969 revision ... Based on the USGS Topographic Map of the Hogansburg Quadrangle 7.5 Minute Series, 1964

* Waste Site Investigation - Alcoa Massena Operations, submitted by Aluminum Company of America, Massena, NY, prepared by Engineering Science, March 1987)

Is there tidal influence?

There is no tidal influence.

Distance to a Sensitive Environment

Distance to a 5-acre (minimum) coastal wetland, if 2 miles or less:

None within 2 miles.

Distance to a 5-acre (minimum) fresh-water wetland if 1 mile or less:

Adjacent to the defined site (Grasse and St Lawrence Rivers).

Assigned value of 3.

(Reference: NYSDEC Wetlands Inventory Overlay of the Hogansburg and Raquette River Quadrangles)

Distance to critical habitat of an endangered species or national wildlife refuge, if 1 mile or less:

Defined Site includes a portion of the St Lawrence River which is a critical hahitat for the Bald Eagle (ie. wintering grounds).

This water supply serves 500 residents in the western areas of the St Regis Mohawk Indian Nation.

Note: Served population identified in the New York State Atlas of Water System Sources, 1982 is only 100.

(References:

* Draft Remedial Investigation Report for Remedial Investigation / Feasibility Study at the General Motors Corporation - Central Foundry Division - Massena Facility, Massena, NY, prepared by RMT, Inc., May 1986

* New York State Atlas of Water System Sources 1982, published by NYS Department of Health)

Name/Description of nearest of above water bodies:

The continuation of the St Lawrence River is the nearest water body to the defined site (Grasse and St Lawrence Rivers).

(References:

* Planimetric Map of the Hogansburg Quadrangle, NYSDOT, 1969 revision ... Based on the USGS Topographic Map of the Hogansburg Quadrangle 7.5 Minute Series, 1964

* Planimetric Map of the Raquette River Quadrangle, NYSDOT, 1968 revision ... Based on the USGS Topographic Map of the Raquette River Quadranqle 7.5 Minute Series, 1964

Distance to above-cited intakes, measured in stream miles:

Distance from the most downstream sampling point showing contamination in excess of New York State Ambient Water Quality Standards for PCB (0.01 ppb) in Class A Surface Waters to the above-cited intake is approximately 2.9 stream miles.

(References:

* NYSDEC Division of Water Technical and Operational Guidance Series Memorandum (85-W-38), Ambient Water Quality Standards and Guidance Values, July 24, 1985

* Planimetric Map of the Hogansburg Quadrangle, NYSDOT, 1969 revision ... Based on the USGS Topographic Map of the Hogansburg Quadrangle 7.5 Minute Series, 1964

* St Lawrence River PCB Sampling Survey near Massena, NY, NYSDEC, 1982 (09/21/82))

Assigned value of 3.

(Reference: NYSDEC Region 6, Darrell Sweredoski - Personal Communication, 1987)

Population Served by Surface Water

Location(s) of water-supply intake(s) within 3 miles (free-flowing bodies) or 1 mile (static water bodies) downstream of the hazardous substance and population served by each intake:

Water Supply Intake for the St Regis Mohawk Indian Nation located along the southern shore (Raquette Point) of the St Lawrence River approximately 2.9 miles downstream from the most downstream sampling point showing contamination in excess of New York State Ambient Water Quality Standards for PCB (0.01 ppb) in Class A Surface Waters.

(References:

* New York State Atlas of Water System Sources 1982, published by NYS Department of Health

* NYSDEC Division of Water Technical and Operational Guidance Series Memorandum (85-W-38), Ambient Water Quality Standards and Guidance Values, July 24, 1985

* Planimetric Map of the Hogansburg Quadrangle, NYSDOT, 1969 revision ... Based on the USGS Topographic Map of the Hogansburg Quadrangle 7.5 Minute Series, 1964)

This water supply serves 500 residents in the western areas of the St Regis Mohawk Indian Nation.

Note: Served population identified in the New York State Atlas of Water System Sources, 1982 is only 100.

(References:

* Draft Remedial Investigation Report for Remedial Investigation / Feasibility Study at the General Motors Corporation - Central Foundry Division - Massena Facility, Massena, NY, prepared by RMT, Inc., May 1986

* New York State Atlas of Water System Sources 1982, published by NYS Department of Health)

Computation of land area irrigated by above-cited intake(s) and conversion to population (1.5 people per acre):

No known land irrigated by above-cited intake.

Total population served:

AIR ROUTE

1 OBSERVED RELEASE

Contaminants Detected:

There is no observed release.

Assigned value of zero.

Date and location of detection of contaminants:

No air survey has been conducted.

Methods used to detect the contaminants:

No air survey has been conducted.

Rationale for attributing the contamiants to the site:

There is no observed release.

Assigned value of zero.

* * *

2 WASTE CHARACTERISTICS

<u>Reactivity and Incompatibility</u>

Most Reactive Compound:

No known reative compounds present.

Assigned value of zero.

Most incompatible pair of compounds:

No known incompatible compounds present.

Assigned value of zero.

<u>Toxicity</u>

Most toxic compound:

PCB Aroclor 1016/1242
Aroclor 1254
Aroclor 1248

Assigned value of 3.

(References:

* Sediment Sample Data from NYS PCB Sampling of the Grasse and St Lawrence Rivers in the vicinity of Massena, NY, NYSDEC Region 6, 1980 (09/17/80)

* St Lawrence River PCB Sampling Survey near Massena, NY, NYSDEC, 1982 (09/21/82)

* St Lawrence River Sampling in the vicinity of Reynolds Metals, NYSDEC Region 6, 1986 (08/20/86))

<u>Hazardous Waste Quantity</u>

Total quantity of hazardous waste:

An estimated 16,204 cubic yards of St Lawrence River sediment having PCB concentrations of at least 50 ppm (considered hazardous waste under TSCA and 6NYCRR 370) is used as a minimum hazardous waste quantity.

A value of 8 is assigned for quantity.

Note: The PCB contaminated river sediments within the defined site are considered in this factor evaluation based on the probable interaction between: the contaminated river sediments and the river water; and the (subsequently contaminated) river water and the air. Interaction between the contaminated river sediments and the river water is suggested by the detection of PCBs in the St Lawrence River water column near the Reynolds Metals and the GM Plants (see Appendix I). Interaction between the river water and the air is suggested by the visual identification of a "rainbow sheen" (hydrocarbon film) floating (and acting as a dispersive media to the air) on the St Lawrence River surface in the vicinity of sample location 6090107W during the 1982 NYSDEC sampling effort.

(Reference: Draft Remedial Investigation Report for Remedial Investigation / Feasibility Study at the General Motors Corporation - Central Foundry Division - Massena Facility, Massena, NY, prepared by RMT, Inc., May 1986)

The quantity of PCBs discharged to the Grasse and St Lawrence Rivers is unknown.

Basis of estimating and/or computing waste quantity:

It is assumed the average thickness of sediments contaminated with > 50 ppm PCB concentration is 2.5 feet. It is also assumed that the area in which concentrations of at least 50 ppm are found extends from the west edge of the bay to 250 feet form shore and to 350 feet downstream from the GM outfall (see Map A-1). The resulting figure is a rectangle with a long dimension of

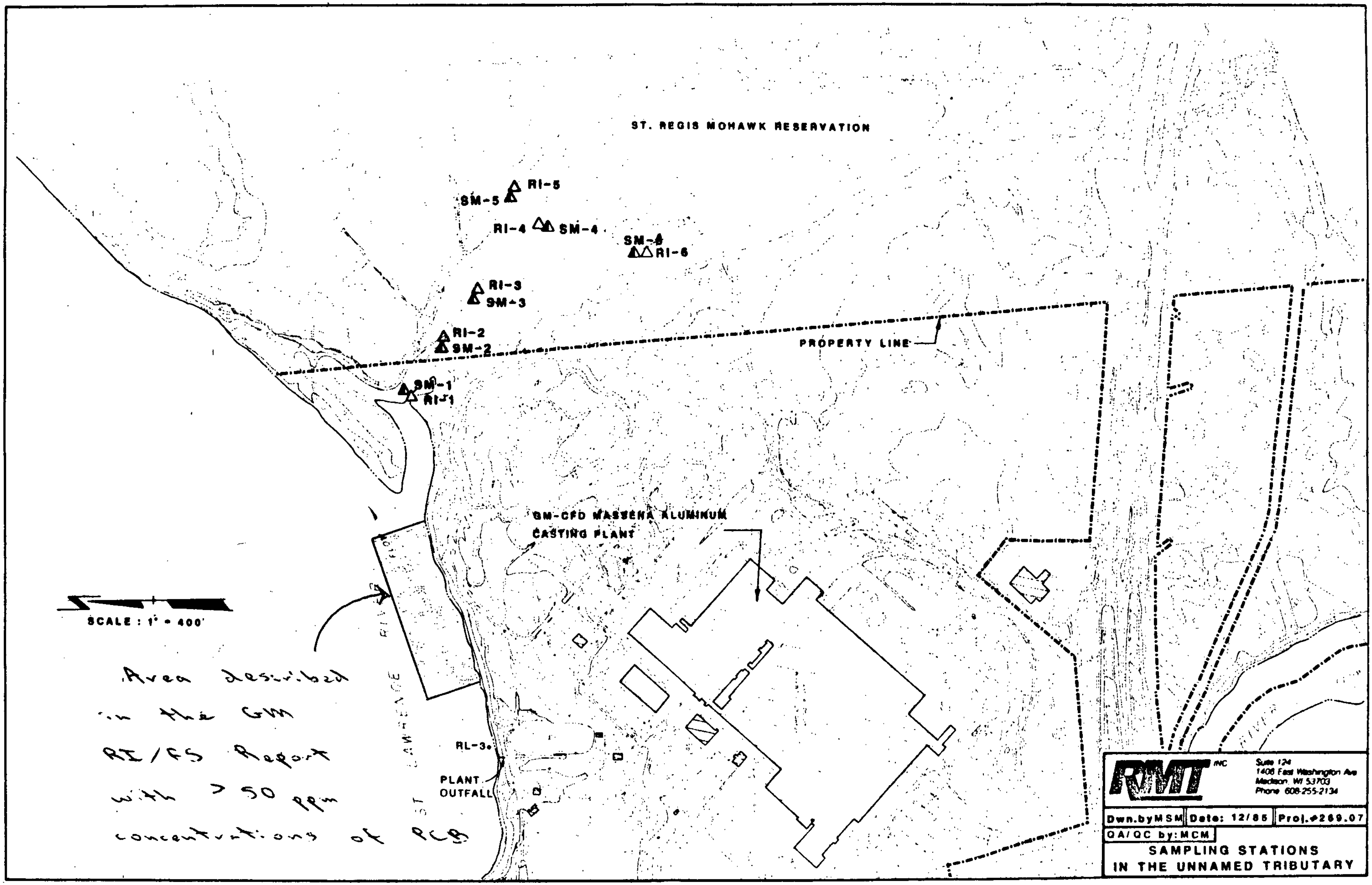


FIGURE 5-4

Map A-1

approximately 700 feet and a short dimension of around 250 feet.

The assumed extent results in 16,204 cubic yards.

(700')(250')(2.5') = 437,500 cubic feet
(437,500 cubic feet)/(27 cubic feet) = 16,204 cubic yards

Note: The average water content of the river sediments is 43%. The dry volume of PCB contaminated soil is 9,236 cubic yards. (16,204 cubic yards)(.57 (soil content)) = 9,236 cubic yards

(Reference: Draft Remedial Investigation Report for Remedial Investigation / Feasibility Study at the General Motors Corporation - Central Foundry Division - Massena Facility, Massena, NY, prepared by RMT, Inc., May 1986)

Note: <u>This is a minimum figure.</u> The figure is an estimate for the River sediments in the vicinity of the GM plant and does <u>not</u> include River sediments with similar concentrations in the vicinity of the Alcoa Plant or the Reynolds Plant.

* * *

3 TARGETS

<u>Population within 4-Mile Radius</u>

Circle radius used, give population, and indicate how determined:

0 to 4 mi   0 to 1 mi   0 to 1/2 mi   0 to 1/4 mi

Population within 0 to 4 miles is 19,168.6 people.

A total of 1,097 houses were counted within a 4 mile radius of the defined site (excluding those inside the Massena Urban Area Boundary) using the Planimetric Maps of the Hogansburg, Massena and the Raquette River Quadrangles. Each house is assumed to have 3.8 residents for a total of 4,168.6 people. The assumed population within the Massena Urban Area Boundary is 15,000 people.

Therfore the total population is 15000 + 4168.6 = 19168.6 people.

Assigned a value of 21.

(References:

* Planimetric Map of the Hogansburg Quadrangle, NYSDOT, 1969 revision ... Based on the USGS Topographic Map of the Hogansburg Quadrangle 7.5 Minute Series, 1964

* Planimetric Map of the Massena Quadrangle, NYSDOT, 1968 revision ... Based on the USGS Topographic Map of the Massena Quadrangle 7.5 Minute Series, 1964

* Planimetric Map of the Raquette River Quadrangle, NYSDOT, 1968 revision ... Based on the USGS Topographic Map of the Raquette River Quadrangle 7.5 Minute Series, 1964

* Waste Site Investigation - Alcoa Massena Operations, submitted by Aluminum Company of America, Massena, NY, prepared by Engineering Science, March 1987)

Distance to a Sensitive Environment

Distance to a 5-acre (minimum) coastal wetland, if 2 miles or less:

None within 2 miles.

Distance to a 5-acre (minimum) fresh-water wetland if 1 mile or less:

Adjacent to the defined site (Grasse and St Lawrence Rivers).

Assigned value of 3.

(Reference: NYSDEC Wetlands Inventory Overlay of the Hogansburg and Raquette River Quadrangles)

Distance to critical habitat of an endangered species, if 1 mile or less:

Defined Site includes a portion of the St Lawrence River which is a critical habitat for the Bald Eagle (ie. wintering grounds).

Assigned value of 3.

(Reference: NYSDEC Region 6, Darrell Sweredoski - Personal Communication, 1987)

Land use

Distance to commercial/industrial area, if 1 mile or less:

Alcoa Plant, Reynolds Metals Plant, and the GM-Central Foundry are less than 1/4 mile from the defined site.

Assigned value of 3.

(References:

* Planimetric Map of the Hogansburg Quadrangle, NYSDOT, 1969 revision ... Based on the USGS Topographic Map of the Hogansburg Quadrangle 7.5 Minute Series, 1964

* Planimetric Map of the Massena Quadrangle, NYSDOT, 1968 revision ... Based on the USGS Topographic Map of the Massena Quadrangle 7.5 Minute Series, 1964

* Planimetric Map of the Raquette River Quadrangle, NYSDOT,

1968 revision ... Based on the USGS Topographic Map of the Raquette River Quadrangle 7.5 Minute Series, 1964)

Distance to national or state park, forest, or wildlife reserve, if 2 miles or less:

Robert Hoses State Park is approximately 4/10 of a mile away from the defined site (at closest point).

Assigned a value of 2.

(References:

* Planimetric Map of the Hogansburg Quadrangle, NYSDOT, 1969 revision ... Based on the USGS Topographic Map of the Hogansburg Quadrangle 7.5 Minute Series, 1964
* Planimetric Map of the Massena Quadrangle, NYSDOT, 1968 revision ... Based on the USGS Topographic Map of the Massena Quadrangle 7.5 Minute Series, 1964
* Planimetric Map of the Raquette River Quadrangle, NYSDOT, 1968 revision ... Based on the USGS Topographic Map of the Raquette River Quadrangle 7.5 Minute Series, 1964)

Distance to residential area, if 2 miles or less:

Massena Urban Area is approximately 500 feet away from the defined site (at closest point).

Assigned value of 3.

(References:

* Planimetric Map of the Hogansburg Quadrangle, NYSDOT, 1969 revision ... Based on the USGS Topographic Map of the Hogansburg Quadrangle 7.5 Minute Series, 1964
* Planimetric Map of the Massena Quadrangle, NYSDOT, 1968 revision ... Based on the USGS Topographic Map of the Massena Quadrangle 7.5 Minute Series, 1964
* Planimetric Map of the Raquette River Quadrangle, NYSDOT, 1968 revision ... Based on the USGS Topographic Map of the Raquette River Quadrangle 7.5 Minute Series, 1964

Distance to agricultural land in production within past 5 years, if 1 mile or less:

No known agricultural land in production within past 5 years within 1 mile or less of the defined site.

Distance to prime agricultural land in production within past 5 years, if 2 miles or less:

No known prime agricultural land in production within past 5 years within 2 miles or less of the defined site.

Is a historic or landmark site (National Register of Historic Places or National Natural Landmarks) within view of the site?

No known historic or landmark site within view of the defined site.

APPENDIX I
ST LAWRENCE - GRASSE RIVER SYSTEM
DOCUMENTATION ILLUSTRATING THE OBSERVED RELEASE OF CONTAMINANTS

Demonstrated release to Grasse River Sediments from ALCOA of:

PCB
- Aroclor 1016/1242
- Aroclor 1254

Sediment Sample Concentrations (in ppm)

		Aroclors	1016/1242	1254
Upstream of the ALCOA Discharge weir	Upstream in Grasse River	Sample #9	<.002	.007
	Power Canal Discharge to Grasse River	Sample #6	.040	.040
Downstream of ALCOA Discharge weir	ALCOA Launch Site on the Grasse River	Sample #5	49.0	8.70

(Reference: * Sediment Sample Data from NYS PCB Sampling of the Grasse and St Lawrence Rivers in the vicinity of Massena, NY, NYSDEC Region 6, 1980 (09/17/80))

Note: The symbol < means that the actual result is less than the number indicated.

See Map for Sample Locations.

Demonstrated release to St Lawrence Sediments from REYNOLDS METALS of:

Polychlorinated Biphenyls
Poiynuclear Aromatic Hydrocarbons

Sediment Sample Concentrations (in ppm)

		Aroclors					Undifferentiated		
		1016/1242	1254	1221	1260	1248	PAH	PCB	MIREX
Upstream of the Reynolds Metals Discharge Points	Upstream in St Lawrence off Massena Point (Upstream of Pollys Gut) -Sample 6090102S [3]	<.001	<.001	<.001	<.001	.020	---	---	---
	Upstream in St Lawrence in western portion of Pollys Gut -Sample #4 [1]	.010	.002	.002	.002	---	---	---	<.002
	In the Wiley Dondero Canal between Eisenhower and Snell Locks -Sample 6090101S [2]	<.001	<.001	<.001	<.001	<.001	---	---	---
	In St Lawrence off southwest end of Cornwall Island -Sample 6090104S [2]	<.001	<.001	<.001	<.001	.010	---	---	---
	Mouth of Grasse River at confluence with the St Lawrence River -Sample #3 [1]	1.60	.430	<.002	<.002	---	---	---	<.002
	Upstream in St Lawrence and downstream of confluence with Grasse River -Sample 01S [3]	---	---	---	---	---	7.45	1.30	---
	Upstream in St Lawrence and downstream of confluence with Grasse River -Sample 6090103S [2]	<.001	<.001	<.001	<.001	.010	---	---	---
Downstream of the Reynolds Metals Discharge Points	100 feet below Reynolds Metals process water discharge to St Lawrence -Sample 03S [3]	---	---	---	---	---	654	19.7	---
	Below the Reynolds Metals process water discharge to St Lawrence -Sample 6090105S [2]	<1.00	<1.00	<1.00	<1.00	18.0	---	---	---
	In Reynolds Cooling Water Discharge Bay on the St Lawrence -Sample 04S [3]	---	---	---	---	---	55.24	13.7	---
	Downstream from Reynolds Metals Cooling Water Discharge Bay -Sample 02S [3]	---	---	---	---	---	32.10	2.40	---
	Further Downstream from Reynolds Metals Cooling Water Discharge Bay -Sample 6090106S [3]	<.001	<.001	<.001	<.001	0.05	---	---	---

(References:

1) Sediment Sample Data from NYS PCB Sampling of the Grasse and St Lawrence Rivers in the vicinity of Massena, NY, NYSDEC Region 6, 1980 (09/17/80)

2) St Lawrence River PCB Sampling Survey near Massena, NY, NYSDEC, 1982 (09/21/82)

3) St Lawrence River Sampling in the vicinity of Reynolds Metals, NYSDEC Region 6, 1986 (08/20/86))

<u>Note: The symbol < means that the actual result is less than the number indicated.</u>

See Map for Sample Locations.

Demonstrated release to <u>St Lawrence Sediments</u> from <u>GENERAL MOTORS</u> of:

PCB → Aroclor 1016/1242
PCB → Aroclor 1254

<u>Sediment Sample Concentrations (in ppm)</u>

			Aroclors 1016/1242	1254
Upstream of the GM Discharge	Upstream of the GM Treated Wastewater Discharge at a point downstream of the Reynolds Discharge	Sample 6090106S	<.001	<.001
Downstream of GM Discharge	100 feet Downstream of the GM Treated Wastewater Discharge to St Lawrence	Sample 6090107S	62.0	<1.00
	Further Downstream of the GM Treated Wastewater Discharge to St Lawrence	Sample 6090108S	<.001	.020

(Reference: * St Lawrence River PCB Sampling Survey near Massena, NY, NYSDEC, 1982 (09/21/82))

<u>Note: The symbol < means that the actual result is less than the number indicated.</u>

See Map for Sample Locations.

Probable release to St Lawrence River Water Column from REYNOLDS of:

PCB Aroclor 1016/1242

and from GENERAL MOTORS of:

PCB — Aroclor 1016/1242
PCB — Aroclor 1254

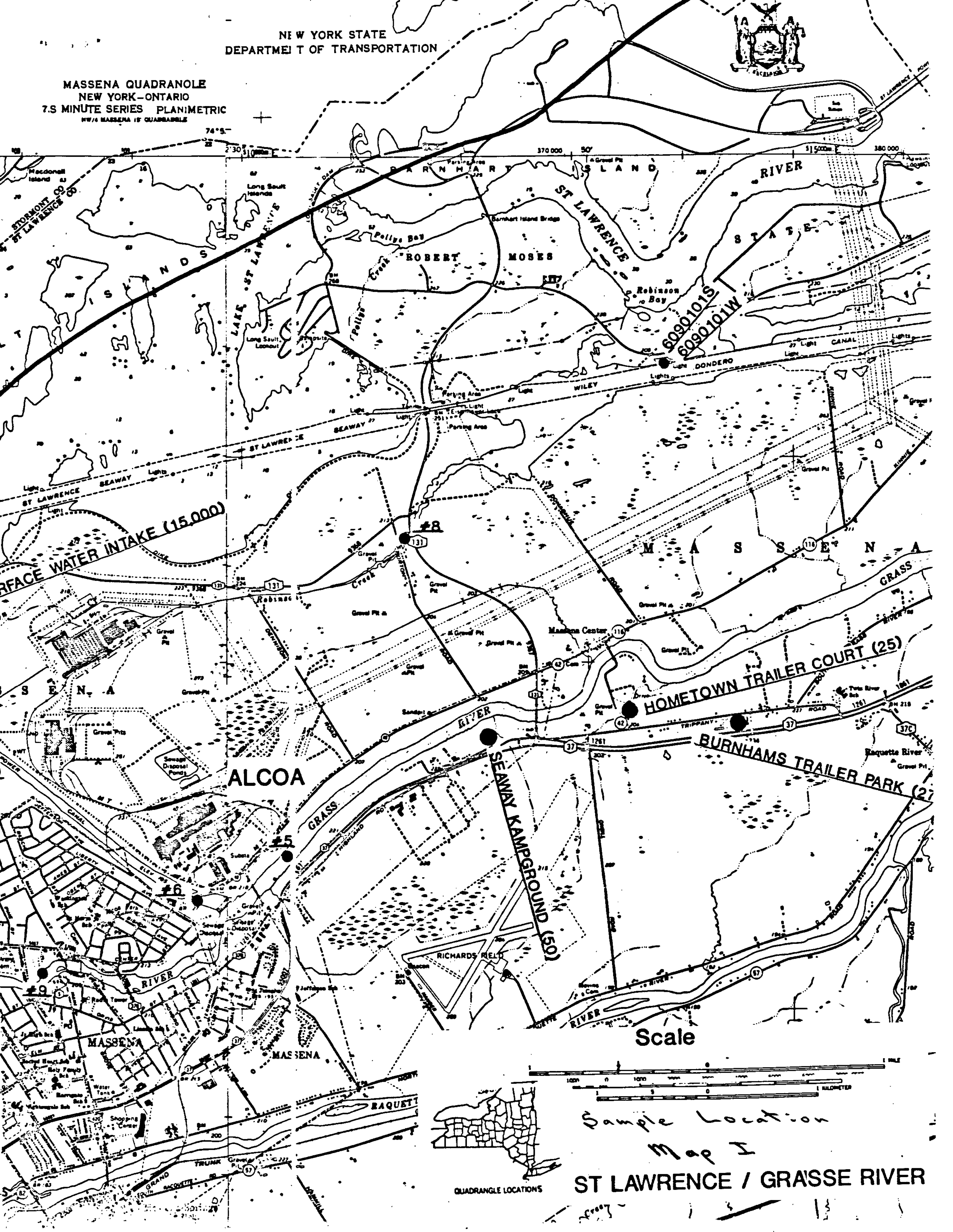
Water Sample Concentrations (in ppm)

			Aroclors	1016/1242	1254
Upstream of the General Motors Discharge Points	Upstream of the Reynolds Metals Discharge Points	Upstream in St Lawrence off Massena Point (Upstream of Pollys Gut)	-Sample 6090102W	<.050	<.050
		In the Wiley Dondero Canal between Eisenhower and Snell Locks	-Sample 6090101W	<.010	<.050
		Upstream in St Lawrence and downstream of confluence with Grasse River	-Sample 6090103W	<.050	<.050
	Downstream of Reynolds Metals	Below the Reynolds Metals process water discharge to St Lawrence	-Sample 6090105W	1.30	.070
Oownstream of GM		100 feet Downstream of the GM Treated Wastewater Discharge to St Lawrence	-Sample 6090107W	41.0	5.80

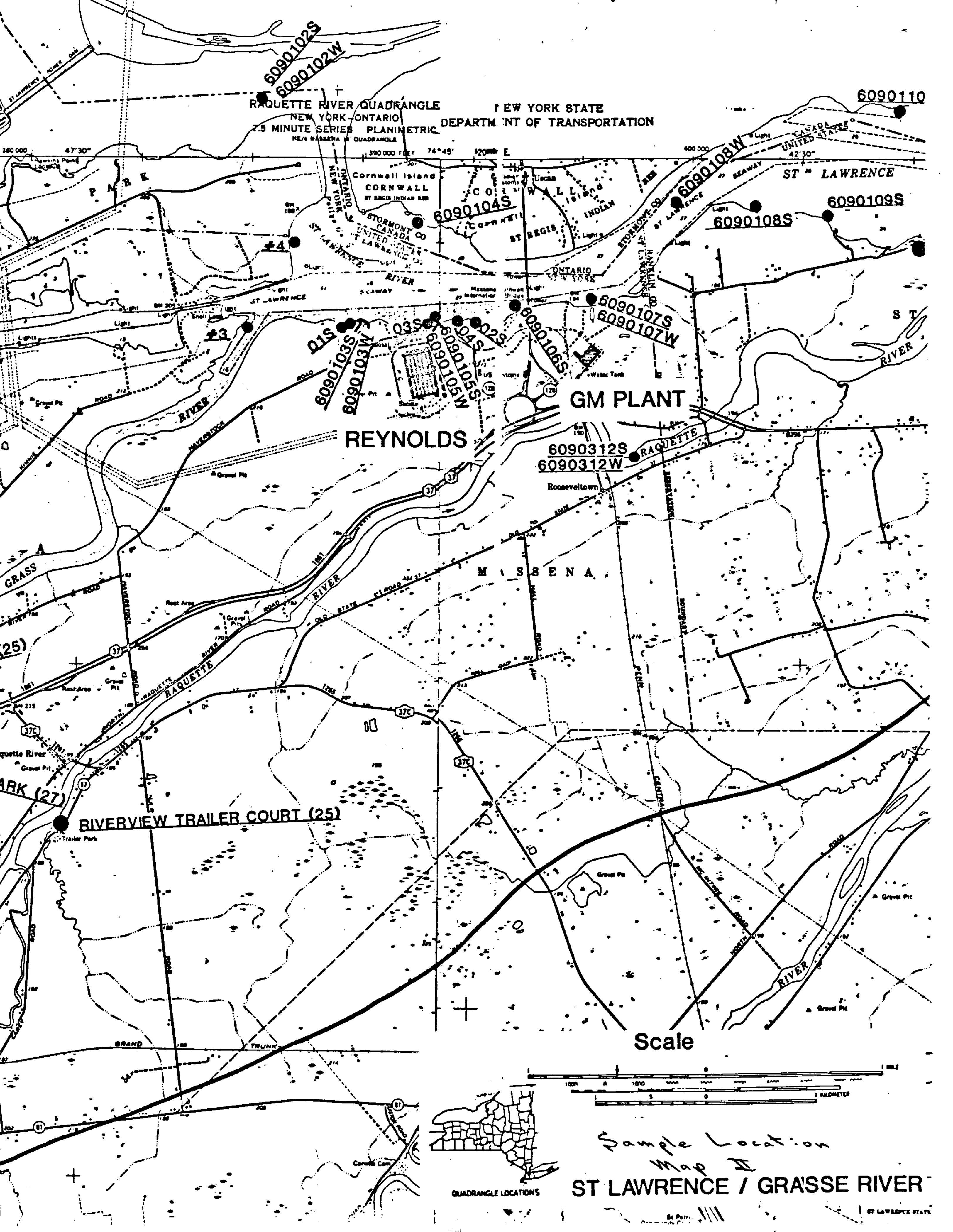
(Reference: * St Lawrence River PCB Sampling Survey near Massena, NY, NYSDEC, 1982 (09/21/82))

Note: The symbol < means that the actual result is less than the number indicated.

See Map for Sample Locations.



Sample Location
Map I
ST LAWRENCE / GRASSE RIVER



RAQUETTE RIVER QUADRANGLE
NEW YORK-ONTARIO
7.5 MINUTE SERIES PLANIMETRIC
NEW YORK STATE
DEPARTMENT OF TRANSPORTATION
6090102S
6090102W
6090110
6090108W
6090109S
6090108S
6090104S
#4
#3
6090107S
6090107W
01S
6090103S
6090103W
03S
6090105S
6090105W
04S
02S
6090106S
GM PLANT
REYNOLDS
6090312S
6090312W
Rooseveltown
MASSENA
RIVERVIEW TRAILER COURT (25)
(25)
ARK (27)
Scale
QUADRANGLE LOCATIONS
Sample Location
Map II
ST LAWRENCE / GRASSE RIVER

APPENDIX II
ST LAWRENCE - GRASSE RIVER SYSTEM
WELLS WITHIN A 3 MILE RADIUS OF THE ST LAWRENCE - GRASSE RIVER SYSTEM

SECTION 1: WELLS IN OVERBURDEN AQUIFER SYSTEM

Well Identification	Well Uses	Comments
455 - 454 - 2	DO	
- 3	DO	
- 4	O	
- 10	O	
- 455 - 1	O	
- 3	DO	
- 4	AO	
- 6	O	
- 9	O	
- 11	DO	
- 13	DO	
- 14	O	
- 16	DO	
- 17	DO	
- 18	DO	
- 19	DO	
- 20	DO	
- 21	DO	
- 22	DO	
- 23	DO	
- 24	DO	
- 27	DO	
- 28	DO	
456 - 454 - 1	DO	
- 2	DO	
- 3	DO	
- 4	DO	
- 5	DO	
- 6	DO	
- 7	O	
- 8	DO	
- 9	D	
- 455 - 1	DO	
- 2	DO	
- 3	DO	
- 4	DO	
- 5	DO	
- 6	DO	
- 7	DO	
- 8	DO	
- 9	DO	

Well Identification	Well Uses	Comments
456 - 455 - 10	DO	
- 11	DO	
- 12	DO	
- 13	O	
- 15	DO	
- 16	DO	
- 17	O	
- 19	DO	
- 20	O	
- 25	DO	
- 27	O	
- 34	O	
- 456 - 11	DO	
- 18	O	
457 - 448 - 1	DO	
- 449 - 1	D	
- 2	DO	
- 3	DO	
- 4	DO	
- 6	DO	
- 7	DO	
- 8	DO	
- 450 - 1	DO	
- 2	DO	
- 6	O	
- 451 - 1	DO	
- 3	DO	
- 6	D	
- 8	D	
- 452 - 3	D	
- 5	D	
- 6	O	
- IS	D	
- 18	D	
- 21	O	
- 22	O	
- 23	O	
- 25	O	

WELLS IN OVERBURDEN AQUIFER SYSTEM (Continued)

Well Identification	Well Uses	Comments
456 - 452 - 26	O	
- 27	O	
- 453 - 4	O	
- 7	O	
- 9	O	
- 10	O	
- 11	O	
- 12	O	
- 22	O	
- 23	O	
- 24	O	
- 454 - 1	O	
- 5	O	
- 7	O	
- 455 - 1	DO	
- 2	O	
- 9b	O	
- 9c	O	
- 10	O	
- 12	O	
- 17	O	
458 - 447 - 1	AO	
- 2	O	
- 3	O	
- 449 - 1	O	
- 450 - 1	DO	
- 2	DO	
- 3	O	
- 4	O	
- 5	O	
- 451 - 1	O	
- 3	O	
- 4	O	
- 5	O	
- 6	O	
- 7	O	
- 8	O	
- 9	O	
- 10	O	
- 11	O	
- 12	O	
- 13	O	

Well Identification	Well Uses	Comments
458 - 451 - 14	O	
- 15	O	
- 19	O	
- 453 - 1	O	
- 2a	O	
- 2b	O	
- 3	O	
- 4	O	
- 7	O	
- 8	O	
- 10	O	
- 11	O	
- 12	O	
- 13	O	
- 14	O	
- 15	O	
459 - 446 - 1	O	
- 2	O	
- 447 - 1	O	
- 2	O	
- 4	O	
- 448 - 1	O	
- 2	O	
- 3	O	
- 4	O	
- 5	O	
- 6	O	
- 449 - 1	O	
- 2	O	
- 3	O	
- 451 - 1	O	
- 2b	O	
- 3	O	
- 4	O	
- 5	O	
- 6	O	
- 7	O	
- 452 - 3	O	
500 - 448 - 3	O	
- 4	O	
- 5	O	

WELLS IN OVERBURDEN AQUIFER SYSTEM (Continued)

Well Identification	Well Uses	Comments	Well Identification	Well Uses	Comments
500 - 448 - 6	O		500 - 449 - 1	O	
- 7	O		- 2	O	
- 8	O		- 3	O	
- 9	O		- 4	O	
- 10	O				
- 11	O		- 451 - 2	O	
- 12	O				
- 14	O				

KEY TO WELL USE

A - Agricultural supply (chiefly for livestock, cooling milk, and sanitation)
D - Domestic supply
O - Observation well

Note: Wells are identified by the latitude/longitude grid system defined on the maps at the end of this Appendix.
The first three numbers represent the last three digits of latitude.
The next three numbers represent the last three digits of longitude.
The last number represents the well number within the set grid.
Only the last number is printed within the grid system on the maps.

SUMMARY of Wells in Overburden Aquifer

* Domestic Wells.......... 62 (54 wells also serve as observation wells)

* Agricultural Wells...... 2 (both wells also serve as observation wells)

* Observation Wells...... 167 (54 wells also serve as domestic wells) (2 wells also serve as agricultural wells)

REFERENCE Groundwater Resources of the Massena - Waddington Area, St. Lawrence County, New York with Emphasis on the Effect of Lake St. Lawrence on Groundwater, by F.W. Trainer and E.M. Salvas, and prepared by the U.S. Geological Survey in cooperation with the Power Authority of the State of New York and the New York Water Resources Commission, Bulletin GW - 47, 1962.

SECTION 2: WELLS IN BEDROCK AQUIFER SYSTEM

Well Identification	Well Uses	Comments	Well Identification	Well Uses	Comments
454 - 451 - 1	D		455 - 455 - 25	M	Motel
- 3	D		- 26	O	
- 4	D		- 31	C	Dairy Queen
-			- 32	I	Sealtest Corp
- 454 - 1	D				
- 3	D		456 - 444 - 3	AD	
- 5	D		- 4	D	
- 7	D				
- 8	D		- 447 - 1	D	
- 9	D		- 2	D	
- 11	D		- 4	M	Trailer Park
			- 6	D	(35 trailers)
- 455 - 1	D		- 7	D	
			- 10	AD	
455 - 448 - 1	M	Trailer Park	- 12	D	
- 3	A				
			- 448 - 1	D	
- 449 - 1	D		- 2	D	
- 4	AD		- 3	AD	
			- 4	D	
- 450 - 1	D		- 5	D	
- 2	M	Trailer Court	- 6	D	
- 3	D	2 houses	- 7	D	
- 4	D				
- 6	M	Trailer Court	- 449 - 1	AD	
- 7	D		- 2	D	
- 8	D				
- 9	A		- 450 - 1	CM	
- 10	D				
			- 451 - 1	D	
- 451 - 7	C		- 2	C	
- 9	O				
			- 452 - 1	C	
- 452 - 1	M	Trailer Court	- 2	C	
- 2	D	(84 trailers)			
- 4	I		- 453 - 1	O	
- 454 - 1	D		- 454 - 10	D	
- 5	O		- 12	D	
- 6	O		- 13	D	
- 7	D				
- 8	D	2 houses	- 455 - 14	DO	
- 9	D		- 22	D	
- 11	D		- 24	M	Trailer Court
			- 26	M	Trailer Court
- 455 - 2	DO		- 28	D	
- 7	M	Village Inn	- 30	D	
- 8	D		- 31	D	
- 10	M	Village Motel	- 33	O	

WELLS IN BEDROCK AQUIFER SYSTEM (Continued)

Well Identification	Well Uses	Comments	Well Identification	Well Uses	Comments
456 - 456 - 1	DO		457 - 452 - 17	D	
457 - 444 - 1	A		- 453 - 2	O	
- 2	AD		- 3	O	
- 3	A		- 5	O	
- 4	D		- 6	O	
			- 8	O	
- 445 - 1	D				
- 2	D	3 families	- 454 - 3	M	Trailer Court
			- 4	O	
- 446 - 1	D		- 6	O	
- 4	A				
- 5	D		- 455 - 4	D	
- 7	D		- 5	DM	Trailer Court
			- 7	O	(11 families)
- 447 - 1	D		- 9a	O	
- 2	M	Trailer Court	- 11	D	
- 3	A		- 16	O	
- 4	A		- 23	C	
- 5	AD				
- 6	D		458 - 443 - 1	D	
- 7	D				
- 9	CD		- 444 - 2	D	
- 10	D		- 7	A	
- 11	D		- 8	D	
- 14	D				
			- 445 - 1	D	
- 448 - 2	M	Trailer Court			
- 3	D		- 447 - 4	AD	
- 4	M	Motel			
- 5	M	Motel	- 448 - 2	AD	
- 6	M	School	- 3	AD	20 families
- 7	D				
- 8	D		- 451 - 2	O	
- 449 - 9	D		- 453 - 2c	O	
- 10	D		- 5	O	
- 11	D		- 9	O	
- 12	M	Restaurant			
- 13	D		- 454 - 2	O	
- 450 - 4	AD		459 - 447 - 6	M	PASNY well
- 5	D		- 7	I	
- 7	O				
- 8	M	Motel	- 451 - 2a	O	
			- 2c	O	
- 451 - 5	DM	18 families			
			- 452 - 2	O	
- 452 - 8	D		- 4	M	Corps of Engrs

WELLS IN BEDROCK AQUIFER SYSTEM (Continued)

Well Identification	Well Uses	Comments	Well Identification	Well Uses	Comments
500 - 448 - 1	O		500 - 449 - 5	D	
- 13	O				

KEY TO WELL USE

A - Agricultural supply (chiefly for livestock, cooling milk, and sanitation)
C - Commercial supply (chiefly for sanitation and service)
D - Domestic supply
I - Industrial supply (chiefly for processing, cooling, sanitation, and service)
M - Municipal or other public supply
O - Observation well

Note: Wells are identified by the latitude/longitude grid system defined on the maps at the end of this Appendix.
The first three numbers represent the last three digits of latitude.
The next three numbers represent the last three digits of longitude.
The last number represents the well number within the set grid.
Only the last number is printed within the grid system on the maps.

SUMMARY of Wells in Bedrock Aquifer

* Domestic Wells.......... 91 (11 wells also serve as agricultural wells)
(1 well also serves as a commercial well)
(3 wells also serve as observation wells)
(2 wells serve two families)
(1 well serves three families)
(1 well serves 11 families (also listed as a municipal well))
(1 well serves 18 families (also listed as a municipal well))
(1 well serves 20 families (also listed as an agricultural well))

* Municipal Wells......... 23 (7 serve Trailer Parks or Courts with unknown trailer occupancy)
(1 serves a Trailer Court (Westbrook Courts) with 100 people)[1]
(1 serves a Trailer Court with 84 trailers)

* Municipal Wells (continued).....
  - (1 serves a Trailer Court with 35 trailers (currently Riverview with 25 people)[1])
  - (1 serves 11 families (also listed as a domestic well))
  - (1 serves 18 families (also listed as a domestic well))
  - (7 serve Motels, Inns and Restaurants)
  - (1 serves a School)
  - (1 well also serves as a commercial well)

* Agricultural Wells...... 19 — (11 wells also serve as domestic wells (1 serves 20 families))

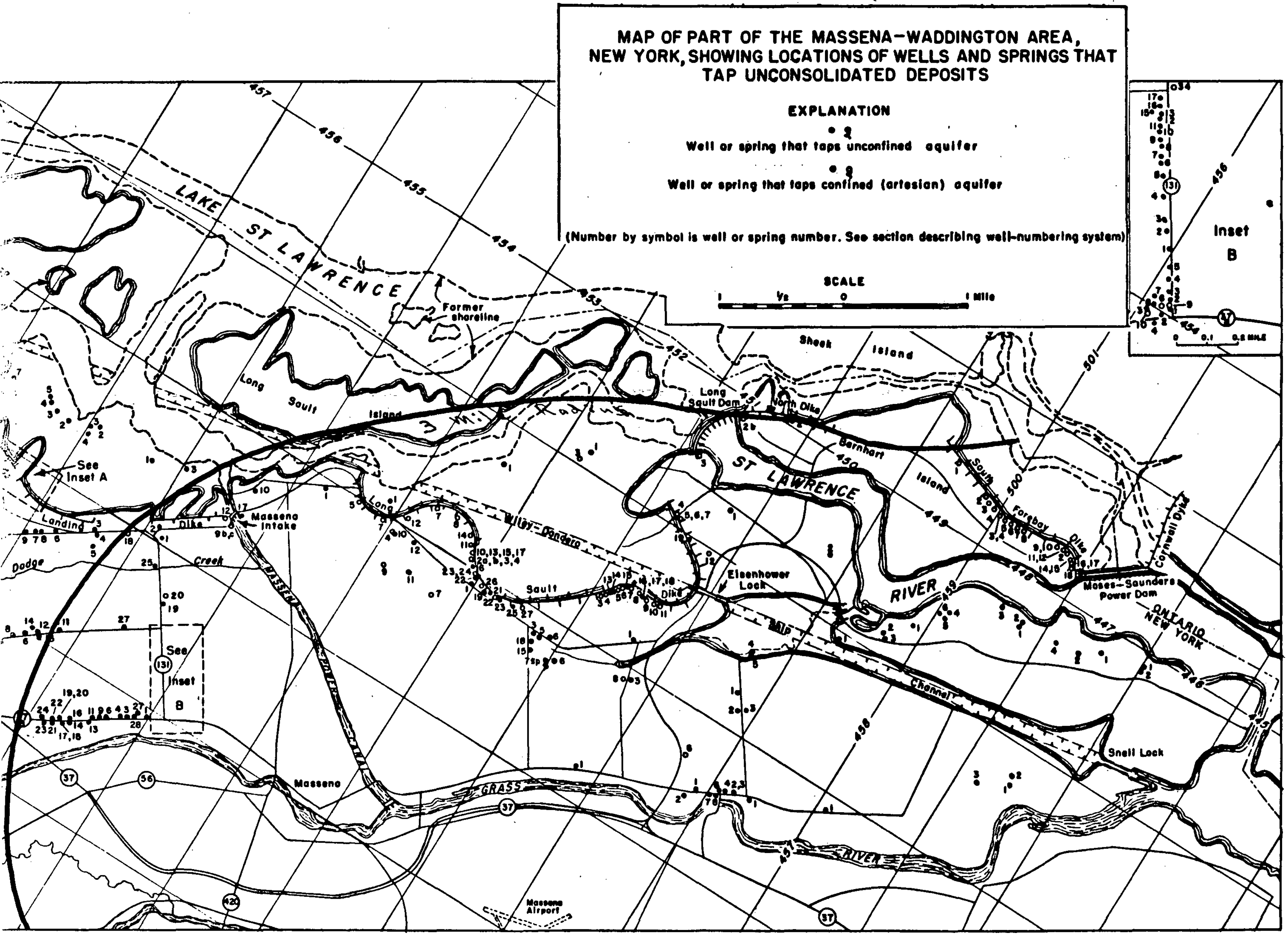
* Commercial Wells........ 8 — (1 well also serves as a domestic well) (1 well also serves as a municipal well)

* Industrial Wells........ 3

* Observation Wells....... 30 — (3 wells also serve as domestic wells)

REFERENCES Groundwater Resources of the Massena - Waddington Area, St. Lawrence County, New York with Emphasis on the Effect of Lake St. Lawrence on Groundwater, by F.W. Trainer and E.M. Salvas, and prepared by the U.S. Geological Survey in cooperation with the Power Authority of the State of New York and the New York Water Resources Commission, Bulletin GW - 47, 1962.

[1] New York State Atlas of Water System Sources 1982, published by NYS Department of Health


MAP OF PART OF THE MASSENA-WADDINGTON AREA, NEW YORK, SHOWING LOCATIONS OF WELLS AND SPRINGS THAT TAP UNCONSOLIDATED DEPOSITS
EXPLANATION
Well or spring that taps unconfined aquifer
Well or spring that taps confined (artesian) aquifer
(Number by symbol is well or spring number. See section describing well-numbering system)
SCALE
1 1/2 0 1 Mile
LAKE ST LAWRENCE
Former shoreline
Long Sault Island
Sheek Island
Long Sault Dam
North Dike
Barnhart Island
ST LAWRENCE RIVER
South Forebay Dike
Cornwall Dyke
Moses-Saunders Power Dam
ONTARIO
NEW YORK
Eisenhower Lock
Long Sault Dike
Wiley-Dondero Ship Channel
Snell Lock
Massena Intake
Landing Dike
Dodge Creek
See Inset A
See Inset B
Inset B
0 0.1 0.2 MILE
Massena
GRASS RIVER
Massena Airport
MASSENA POWER CANAL

MAP SHOWING THE LOCATIONS OF WELLS AND SPRINGS WHICH TAP BEDROCK IN THE MASSENA-WADDINGTON AREA, ST. LAWRENCE COUNTY, NEW YORK, AND BOUNDARIES OF THE BEDROCK FORMATIONS

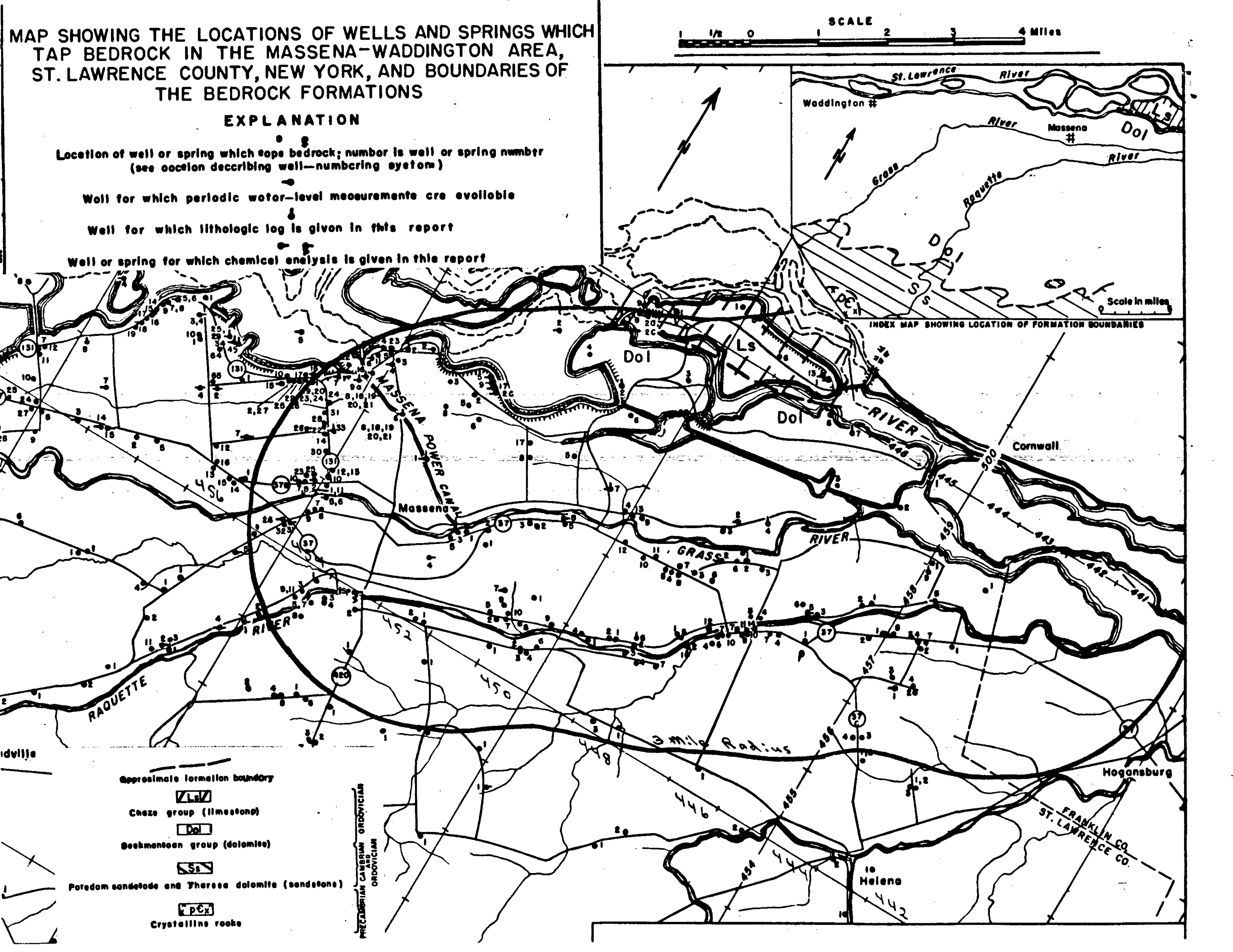
EXPLANATION

Location of well or spring which taps bedrock; number is well or spring number (see section describing well-numbering system)

Well for which periodic water-level measurements are available

Well for which lithologic log is given in this report

Well or spring for which chemical analysis is given in this report



APPENDIX III
ST LAWRENCE - GRASSE RIVER SYSTEM
POPULATION USING GROUNDWATER WITHIN 3 MILES OF THE DEFINED SITE

SECTION 1: POPULATION USING OVERBURDEN AQUIFER SYSTEM

Total population served by groundwater from overburden aquifer system equals 235.6 people.

Rationale

* 62 Domestic Wells known within 3 miles of defined site service 62 households.

  Calculation:
  (62 households)(3.8 people/household) = 235.6 people

SECTION 2: POPULATION USING BEDROCK AQUIFER SYSTEM

Total population served by groundwater from the bedrock aquifer system equals 1112.6 people.

Rationale

* 91 Domestic Wells known within 3 miles of defined site service 141 households.

  Calculation:
  (141 households)(3.8 people/household) = 535.8 people

  ---

* 21 Municipal Wells known within 3 miles of defined site (and not counted under Domestic Wells) service 91 households plus 125 individuals.

  - 84 households from Trailer Court with 84 trailers
  - 7 households assumed as a minimum from the 7 Trailer Parks and Courts with unknown trailer occupancy

  - 100 individuals at Westbrook Trailer Court[1,*]
  - 25 individuals at Riverview Trailer Court[1,*]

  Calculations:
  (91 households)(3.8 people/household) = 345.8 people

  345.8 people + 125 people = 470.8 people

SECTION 2: POPULATION USING BEDROCK AQUIFER SYSTEM (continued)

* 106 People in Trailer Parks (other than those listed above under Municipal Wells) are <u>assumed</u> to be served by the bedrock aquifer. The breakdown is:
  - 54 people in St Lawrence Trailer Court[1]
  - 27 people in Burnhams Trailer Park[1]
  - 25 people in Hometown Trailer Court[1]

  Calculation:
  54 + 27 + 25 = 106 people

Note: Persons working in Motels, Inns, Restaurants, and Campgrounds, and students in school served by wells in the bedrock were <u>not</u> counted because:
a) numbers employed or in attendance not known
and b) double counting might occur.

Summary Calculations:
535.8 + 470.8 + 106 = 1112.6 people

<u>REFERENCES</u> Groundwater Resources of the Massena - Waddington Area, St. Lawrence County, New York with Emphasis on the Effect of Lake St. Lawrence on Groundwater, by F.W. Trainer and E.H. Salvas, and prepared by the U.S. Geological Survey in cooperation with the Power Authority of the State of New York and the New York Water Resources Commission, Bulletin GW - 47, 1962.

[1] New York State Atlas of Water System Sources 1982, published by NYS Department of Health

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Note: [2] These Trailer Courts are listed in the 1982 Atlas of Water System Sources and were matched with wells listed in the 1962 Groundwater Resources Report based on their location.

REFERENCES

CITED IN THE
HAZARD RANKING SYSTEM

SCORING OF THE

FACILITY NAME: St Lawrence - Grasse River System

LOCATION: Grasse and St Lawrence Rivers near Massena in northern Franklin County, New York State

1. Climatic Atlas of the United States, US Department of Commerce, National Climatic Center, Ashville, NC, 1979

2. Draft Remedial Investigation Report for Remedial Investigation / Feasibility Study at the General Motors Corporation - Central Foundry Division - Massena Facility, Massena, NY, prepared by RMT, Inc., May 1986

3. Groundwater Resources of the Massena - Waddington Area, St. Lawrence County, New York with Emphasis on the Effect of Lake St. Lawrence on Groundwater, by F.W. Trainer and E.H. Salvas, and prepared by the U.S. Geological Survey in cooperation with the Power Authority of the State of New York and the New York Water Resources Commission, Bulletin GW - 47, 1962

4. New York State Atlas of Water System Sources 1982, published by NYS Department of Health

5. NYSDEC Division of Water Technical and Operational Guidance Series Memorandum (85-W-38), Ambient Water Quality Standards and Guidance Values, July 24, 1985

6. NYSDEC Region 6, Darrell Sweredoski - Personal Communication, 1987

7. NYSDEC Wetlands Inventory Overlay of the Hogansburg and Raquette River Quadrangles

8. Planimetric Map of the Hogansburg Quadrangle, NYSDOT, 1969 revision ... Based on the USGS Topographic Map of the Hogansburg Quadrangle 7.5 Minute Series, 1964

9. Planimetric Map of the Massena Quadrangle, NYSDOT, 1968 revision ... Based on the USGS Topographic Map of the Massena Quadrangle 7.5 Minute Series, 1964

10. Planimetric Map of the Raquette River Quadrangle, NYSDOT, 1968 revision ... Based on the USGS Topographic Map of the Raquette River Quadrangle 7.5 Minute Series, 1964

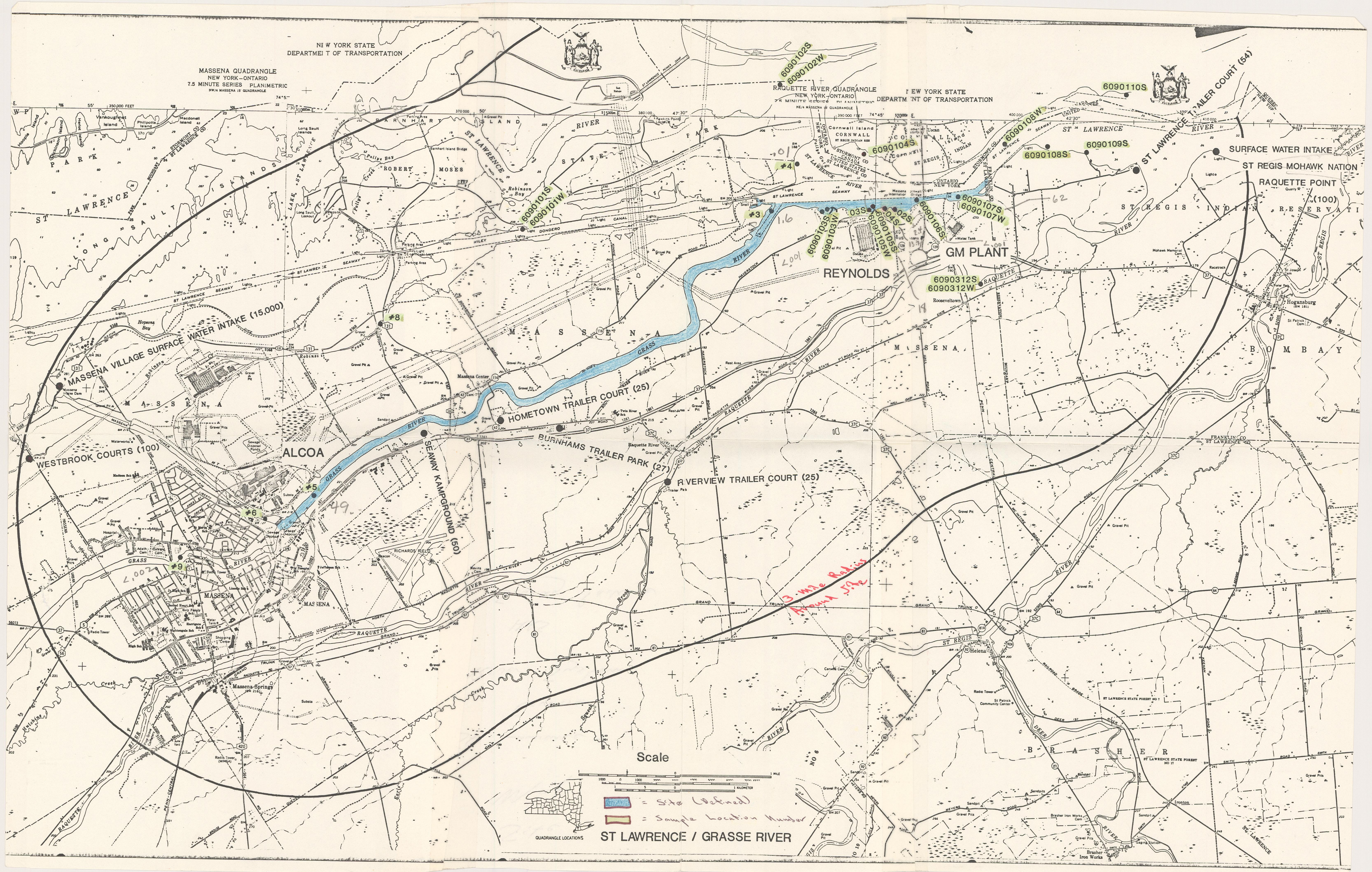
11. Sediment Sample Data from NYS PCB Sampling of the Grasse and St Lawrence Rivers in the vicinity of Massena, NY, NYSDEC Region 6, 1980 (09/17/80)

12. St Lawrence River PCB Sampling Survey near Massena, NY, NYSDEC, 1982 (09/21/82)

13. St Lawrence River Sampling in the vicinity of Reynolds Metals, NYSDEC Region 6, 1986 (08/20/86)

14. Uncontrolled Hazardous Waste Site Ranking System A Users Manual (HW-10), Table 2, USEPA, 1984

15. Waste Site Investigation - Alcoa Massena Operations, submitted by Aluminum Company of America, Massena, NY, prepared by Engineering Science, March 1987


MASSENA QUADRANGLE
NEW YORK–ONTARIO
7.5 MINUTE SERIES PLANIMETRIC
NEW YORK STATE
DEPARTMENT OF TRANSPORTATION
RAQUETTE RIVER QUADRANGLE
NEW YORK–ONTARIO
ALCOA
REYNOLDS
GM PLANT
MASSENA VILLAGE SURFACE WATER INTAKE (15,000)
WESTBROOK COURTS (100)
HOMETOWN TRAILER COURT (25)
BURNHAMS TRAILER PARK (27)
RIVERVIEW TRAILER COURT (25)
SEAWAY KAMPGROUND (60)
ST LAWRENCE TRAILER COURT (54)
SURFACE WATER INTAKE
ST REGIS MOHAWK NATION
RAQUETTE POINT
(100)
6090101S
6090101W
6090102S
6090102W
6090104S
6090107S
6090107W
6090108S
6090108W
6090109S
6090110S
6090312S
6090312W
#3
#4
#5
#6
#8
#9
MASSENA
BOMBAY
BRASHER
ST REGIS INDIAN RESERVATION
3 mile Radius Around Site
Scale
= Site (Stained)
= Sample Location Number
ST LAWRENCE / GRASSE RIVER

REFERENCES

CITED IN THE
HAZARD RANKING SYSTEM

SCORING OF THE

FACILITY NAME: St Lawrence - Grasse River System

LOCATION: Grasse and St Lawrence Rivers near Massena in northern Franklin County, New York State

1. Climatic Atlas of the United States, US Department of Commerce, National Climatic Center, Ashville, NC, 1979

2. Draft Remedial Investigation Report for Remedial Investigation / Feasibility Study at the General Motors Corporation - Central Foundry Division - Massena Facility, Massena, NY, prepared by RMT, Inc., May 1986

3. Groundwater Resources of the Massena - Waddington Area, St. Lawrence County, New York with Emphasis on the Effect of Lake St. Lawrence on Groundwater, by F.W. Trainer and E.H. Salvas, and prepared by the U.S. Geological Survey in cooperation with the Power Authority of the State of New York and the New York Water Resources Commission, Bulletin GW - 47, 1962

4. New York State Atlas of Water System Sources 1982, published by NYS Department of Health

5. NYSDEC Division of Water Technical and Operational Guidance Series Memorandum (85-W-38), Ambient Water Quality Standards and Guidance Values, July 24, 1985

6. NYSDEC Region 6, Darrell Sweredoski - Personal Communication, 1987

7. NYSDEC Wetlands Inventory Map of the Hogansburg Quadrangle

8. Planimetric Map of the Hogansburg Quadrangle, NYSDOT, 1969 revision ... Based on the USGS Topographic Map of the Hogansburg Quadrangle 7.5 Minute Series, 1964

9. Planimetric Map of the Massena Quadrangle, NYSDOT, 1968 revision ... Based on the USGS Topographic Map of the Massena Quadrangle 7.5 Minute Series, 1964

10. Planimetric Map of the Raquette River Quadrangle, NYSDOT, 1968 revision ... Based on the USGS Topographic Map of the Raquette River Quadrangle 7.5 Minute Series, 1964

11. Sediment Sample Data from NYS PCB Sampling of the Grasse and St Lawrence Rivers in the vicinity of Massena, NY, NYSDEC Region 6, 1980 (09/17/80)

12. St Lawrence River PCB Sampling Survey near Massena, NY, NYSDEC, 1982 (09/21/82)

13. St Lawrence River Sampling in the vicinity of Reynolds Metals, NYSDEC Region 6, 1986 (08/20/86)

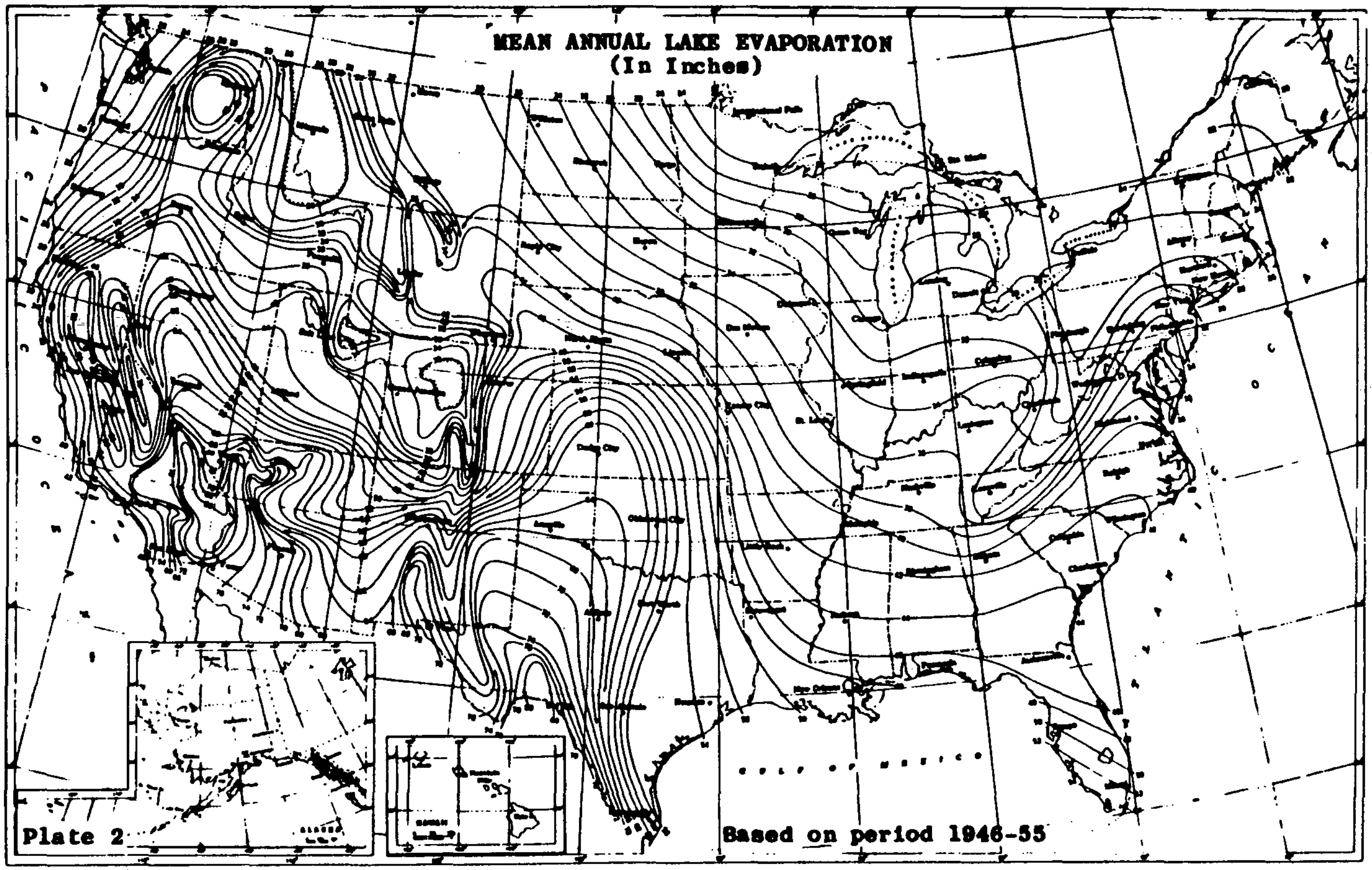
14. Uncontrolled Hazardous Waste Site Ranking System A Users Manual (HW-10), Table 2, USEPA, 1984

15. Waste Site Investigation - Alcoa Massena Operations, submitted by Aluminum Company of America, Massena, NY, prepared by Engineering Science, March 1987

Source: Climatic Atlas of the United States, U.S. Department of Commerce, National Climatic Center, Asheville, N.C., 1979.

NORMAL ANNUAL TOTAL PRECIPITATION (INCHES)

Reference 1.1



Source: Climatic Atlas of the United States, U.S. Department of Commerce, National Climatic Center, Ashville, N.C., 1979.

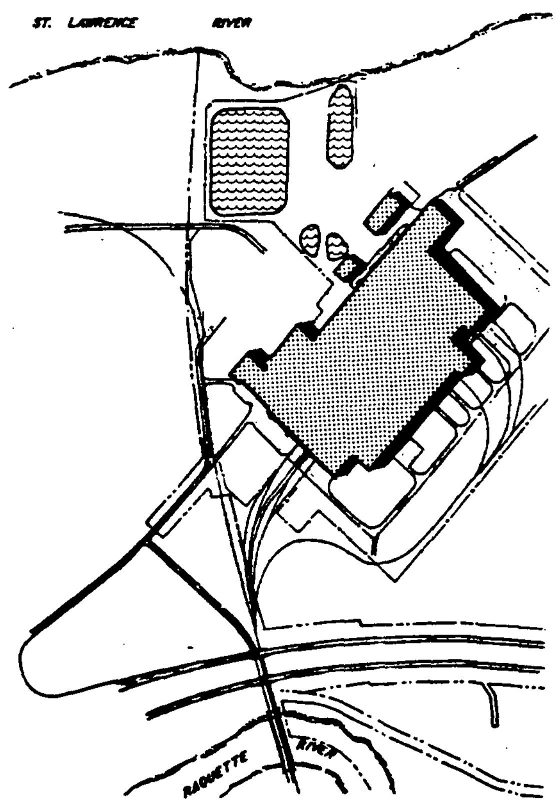
MEAN ANNUAL LAKE EVAPORATION
(IN INCHES)

Reference 2.1

central foundry

GM

DRAFT REMEDIAL INVESTIGATION REPORT FOR REMEDIAL INVESTIGATION / FEASIBILITY STUDY AT GMC-CFD MASSENA FACILITY



MASSENA, NEW YORK
MAY 1986

PREPARED BY:

RMT INC

FOR:

CENTRAL FOUNDRY DIVISION
GENERAL MOTORS CORPORATION

VOLUME I

EXECUTIVE SUMMARY

The General Motors Corporation, Central Foundry Division (GM), has operated an aluminum casting plant in Massena, New York since 1959. Polychlorinated biphenyls (PCBs) were used in the hydraulic fluids for diecasting machines from 1968 until 1973. Sludges containing PCBs from wastewater systems were periodically landfilled in on-site disposal pits. Two inactive wastewater lagoons are also on the facility. The past on-site waste disposal activities resulted in the GM facility being placed on the National Priority List established under CERCLA. A Remedial Investigation/Feasibility Study Workplan was developed by the USEPA REM-FIT contractor (EPA Work Assignment Number 75-2LAG). The workplan was modified and approved by the USEPA, for implementation under a CERCLA Consent Order (USEPA Administrative Order on Consent, Index No. II CERCLA-50201). The Remedial Investigation described in this document is the outcome of the work performed under the Consent Order.

The purpose of the Remedial Investigation (RI) under CERCLA is to determine the nature and extent of the problem(s) posed by the release of hazardous substance(s) to the environment. The data collected must be sufficient for the determination of the necessity for and proposed extent of remedial actions.

The RI for the General Motors-Central Foundry Division (GM) facility in Massena, New York, included several tasks. The geology and ground water flow system evaluation was based on 72 soil borings and 44 monitoring wells installed during the RI, and 120 borings and 29 monitoring wells installed during previous investigations. A total of 665 samples of soil (from boring and surficial sampling) waste and lagoon bottom-sludges and 2 lagoon-water samples were submitted to the laboratory for determination of hazardous substance content and extent. Ground water quality assessments were based on 77 samples from 43 monitoring wells and 67 samples from 36 residential wells on Raquette Point, to the east of the GM facility. Three surface water bodies were Included in the RI: the St. Lawrence River, the Raquette River and a small unnamed tributary to the St. Lawrence River. Thirty water samples and 52 sediment samples were submitted to the laboratory for chemical analyses.

A public health assessment of the risks PCBs pose to residents of Raquette Point, St. Regis Mohawk Reservation, was also completed. The assessment was based on previously reported fish studies and the water quality data collected during the RI.

The major findings of the RI include:

1. The soil and waste sampling and analysis program defined PCB Aroclor 1248 as the predominant hazardous waste constituent. No other Aroclor was detected on land within and adjacent to the GM facility. Minor quantities of polynuclear aromatic hydrocarbons were also found in soil and waste. Inorganic HSL constituents were not found in excess of background concentrations. PCBs could be used effectively as indicators of past waste disposal activities because the PCBs were widely disseminated in the wastes and at high concentrations relative to other waste constituents.

2. The extent of PCBs in soil in the North Disposal Area corresponds to past disposal practices. The volume of soil and waste containing more than 25 mg/kg (dry wt.) of PCBs is estimated to be 72,000 cubic yards.

3. The bulk of the PCB contamination in the East Disposal Area is confined to the past limits of sludge disposal. A volume of soil containing PCBs was also defined to the east of the sludge disposal area. The volume of soil and waste containing more than 25 mg/kg (dry wt.) of PCB is estimated to be 111,000 cubic yards.

4. Sampling of the Industrial Landfill revealed a large body of waste material containing PCBs at depths between 15 and 30 feet below the landfill surface. The volume of soil and waste

containing more than 25 mg/kg (dry wt.) of PCB is estimated to be 170,000 cubic yards.

5. An area of soil fill along the Raquette River with PCB contents up to 400 mg/kg (dry wt.) was also identified.

6. Approximately 100 feet of unconsolidated sediments overlie a regional dolostone aquifer. The sediments are predominantly glacial till with small quantities of fluvial, marine and lacustrine sediments.

7. Ground water in the bedrock aquifer flows toward the St. Lawrence and Raquette Rivers. The St. Lawrence River is a discharge area for the aquifer. Strong upward gradients into the overlying sediments are found under the northern third of the GM facility.

8. Ground water in the shallow (< 50-foot depth) sediments flows toward the St. Lawrence and Raquette Rivers and the unnamed tributary. The unnamed tributary forms a hydrologic divide between the GM facility and Raquette Point.

9. Two potential waste constituent pathways were defined: one is within a surficial glaciofluvial deposit extending eastward from the East Disposal Area; and the second is within a deeper glaciofluvial deposit (10-feet thick and 20 to 40 feet below ground) that underlies the North and East Disposal Areas and the Industrial Landfill. The deeper pathway extends northward and eastward to the St. Lawrence River and the unnamed tributary.

10. Distribution of waste constituents in ground water is limited to a small area below and adjacent to the disposal areas. Waste constituents have migrated to the deep glaciofluvial deposit and are probably reaching the St. Lawrence River and the lower reaches of the unnamed tributary. The observed waste constituents in ground water include: PCB Aroclor 1248, phenols, polynuclear aromatic hydrocarbons and volatile organic compounds (in a very limited number of samples).

11. Residential and public water supplies were found to be essentially free of PCBs and other HSL constituents

12. Low concentrations (< 2 ug/l) of PCB Aroclor 1248 were observed in water samples from the Raquette River and the unnamed tributary. PCB concentrations in the St. Lawrence River ranged from 7.5 ug/l of 1248 to less than 0.5 ug/l. The highest concentrations were found upstream of the GM facility.

13. Raquette River sediment samples contained both Aroclor 1248 and 1232 at concentrations less than 2.5 mg/kg (dry wt.) downstream of the soil fill area.

14. The unnamed tributary sediments contained PCB Aroclor 1248 at concentrations between 48 and 0.39 mg/kg (dry wt.). The PCBs probably originate in surface runoff from the GM facility and limited ground water discharge.

15. The sediments in the St. Lawrence River contain both PCB 1248 and 1232 Aroclors. The 1232 Aroclor predominates in almost all upstream samples and samples adjacent to the GM facility. Total PCB contents in the sediments adjacent to the facility reach 5,500 mg/kg (dry wt.).

16. US FDA and EPA models were used to assess the potential risk of cancer for Raquette Point residents consuming fish, surface water and ground water.

17. The incremental risk of cancer attributable to fish consumption is estimated to be 60 cancers in 100,000 people. The risk attributable to surface water ranges from 1 in 10,000 to 1 in 100,000 and for ground water the risk is estimated to be no greater than 1 in 100,000.

18. The 1 in 100,000 excess cancer risk is based on the analytical detection limit for PCBs under the USEPA Contract Laboratory Program. This risk is the lowest possible risk that can be determined with EPA approved analytical techniques; thus the degree of risk may be overstated.

2. SITE DESCRIPTION

2.1 Physiography, Climatology, and Geology

The GM-CFD site property is located in the St. Lawrence Lowlands physiographic province. The site is relatively flat (approximately 50 feet of local relief) with steep slopes along the St. Lawrence River, the Raquette River, and the Industrial Landfill. Land surface elevations are between 155 and 220 feet above sea level.

Table 2-1 presents mean temperature and precipitation and snowfall values for this region. Winters are generally long and cold, with daytime temperatures usually ranging from 30°F to 35°F. Extended periods of sub-zero temperature, however, are not uncommon. The summer climate is moderate with daytime highs averaging 70°F to 80°F. During brief intervals of sultry conditions, temperatures of 90°F or higher occur. Minimum nighttime temperatures average 50°F but nighttime readings of 40°F or lower are not uncommon.

Precipitation distribution is fairly uniform during the year, ranging from an average of 2.06 inches in January to 3.47 inches in August. Total snowfall is generally over 70 Inches a year. Continuous snow cover begins to develop by late November and early December and persists through March. The mean annual evapotranspiration rate for the area Is about 18 inches.

Winds are generally from the west. The annual average wind speed in the St. Lawrence River Valley is about 10 miles per hour. The strongest winds are observed during the winter months.

The bedrock beneath the facility consists of dolostone, limestone, sandstone, and shale of the Ogdensburg Dolostone, Ordovician Beekmantown Group (Isachsen & Fisher, 1970). The bedrock is fractured by joints and

Table 2-1

Climatological Summary for Massena, New York
for National Weather Service Station, Massena FAA Airport[3]

MONTH	(°F)	PRECIPITATION (IN.)[1]	SNOWFALL (IN.)[2]
January	14.4	2.06	14.9
February	16.6	2.29	17.9
March	27.7	2.09	10.3
April	42.6	2.62	1.6
May	54.3	2.71	0.4
June	64.1	2.97	0.0
July	68.5	3.04	0.0
August	66.1	3.47	0.0
September	58.3	3.02	0.0
October	47.7	2.52	0.4
November	35.5	2.99	5.8
December	20.3	3.23	19.5
ANNUAL	43.0 (Avg)	33.01 (Total)	70.8 (Total)

NOTES:

[1]All precipitation values are in inches of precipitable water.

[2]Snowfall amounts indicated are Included in the corresponding amount of precipitation listed.

[3]From: NUS, Inc. 1984. Workplan for Remedial Investigation/Feasibility Study for the General Motors Corporation Central Foundry Division Site, St. Lawrence County, New York. NUS Proj. No. 0790.01, EPA Work Assignment No. 75-2LAG.

isolated faults, with the faults trending northeast-southwest (Trainer & Salvas, 1962). An east-west trending bedrock valley is located beneath the site. Elevation of the bedrock surface ranges from 75 feet (MSL) in the northern portion of the site to 120 feet (MSL) in the southern portion of the site.

Approximately 100 feet of Pleistocene sediments cover the bedrock in the vicinity of the GM facility. The sediments are the result of late Wisconsinian glaciation (MacClintock and Stewart, 1965). Most of these sediments consist of glacial till. in portions of the site, varved lacustrine silt and clay and glaciofluvial deposits consisting of silty sand are found within the till. Marine clay and glaciofluvial deposits of silty sand are found overlying the till in parts of the site.

The ground water table is located from 5 to 15 feet below the ground surface in the study area. The water table elevations rise and fall in response to seasonal variations in ground water recharge. Water levels generally reach their peak elevation in March and April (following spring snowmelt) and their annual lows in August or September (Trainer & Salvas, 1962). There are no extensive aquifers in the Pleistocene sediments, but the sandy outwash layers provide local permeable zones that could be used for small-scale residential water supplies (Trainer and Salvas, 1962). The permeable zones could also act as potential migration pathways for hazardous substances. Ground water in the Pleistocene sediments flows northward toward the St. Lawrence River, eastward in the direction of the St. Regis Mohawk Reservation, and southward toward the Raquette River. Water quality in the glacial sediments is characterized by dissolved solids content less than 500 mg/l and chloride concentrations less than 20 mg/l (Trainer & Salvas, 1962). The water is generally a calcium-magnesium:bicarbonate water that reflects the high dolomite (calcium-magnesium carbonate) of the glacial sediments (Trainer & Salvas, 1962).

The Ogdensburg dolostone forms a confined to semi-confined aquifer beneath the site. Ground water in the bedrock flows to the northwest, southeast, and northeast from a northeast-southwest trending piezometric divide. The bedrock unit forms a regional aquifer in upstate New York in which flow is generally northeastward towards the St. Lawrence River.

Local potentiometric highs form beneath the ridges that separate the region's rivers. The high areas are indicative of ground water recharge to the rock. The flow patterns also indicate that ground water in the shallow bedrock subsequently discharges to rivers in the area. A potentiometric high was mapped beneath the GM facility in 1958 (Trainer & Salvas, 1962) and during the course of the RI. Trainer & Salvas (1962) divide the Ogdensburg dolostone into two aquifers with only the shallow portions of the bedrock aquifer interacting with shallower flow systems in the glacial sediments.

The water in the bedrock is generally of a calcium-magnesium-sodium:sulfate-chloride type with dissolved solids content in excess of 500 mg/l (Trainer & Salvas, 1962). Hydrogen sulfide is also common, especially in areas of ground water discharge. Trainer & Salvas (1962) observed concentrations of H_2S between 0.4 and 33 mg/l (median value of 2.6 mg/l). They postulate that the water chemistry is derived from dissolution of dolomite and gypsum, oxidation of pyrite, formation of sulfide by anaerobic bacteria, and incorporation of connate brines or Champlain Sea marine waters.

2.2 Demography and Land Use

The GM facility is located in a rural area in northern New York. The population is thinly spread across the region in small towns and villages with populations ranging from less than 100 to 10,000 people. Farms (predominantly dairy) and rural residences are scattered between the villages.

The GM facility is located in a rural area approximately 7 miles west of the Village of Massena (pop. 13,000) and approximately 2 miles south of the City of Cornwall, Ontario (pop. 50,000). The immediate vicinity of the plant has few residents. Most area residents are found on Raquette Point, immediately east of the facility (Figure 2-1). The Point is part of the St. Regis Mohawk Reservation. A survey conducted by the Reservation Health Services in the Fall of 1985 identified 190 residents in this area.

Land-use in the immediate vicinity of the plant is largely forest, farmland returning to forest, or wetlands (Figure 2-1). The area is crossed by several right-of-ways belonging to the State of New York, St. Lawrence and Franklin Counties or the St. Lawrence International Seaway Commission. An aluminum reduction facility operated by the Reynolds Metals Company is located to the west of the GM facility, and a metal reclamation facility operated by Minerals Reprocessing Corp. is south of the GM facility.

2.3 Natural Resources

Both surface and ground water are important natural resources in the vicinity of the GM-CFD Massena site. Residents of Raquette Point obtain drinking water from wells or directly from the St. Lawrence

Figure 2-1

missing

River. Most residents (55 percent), a school (Raquette Point Freedom School), and five commercial establishments obtain potable water from wells completed in glacial deposits or the Ogdensburg dolostone. An additional 10 percent of the residents draw water directly from the St. Lawrence River. Approximately 20 percent of the Raquette Point residents obtain potable water from the St. Regis Mohawk Reservation public water system which draws water from the St. Lawrence River immediately downstream from the mouth of the Raquette River. The source of water for about 15 percent of the Raquette Point residents was not determined.

Surface water areas and their associated wetlands also serve as a habitat for fish and wildlife which are an important source of food for some residents of Raquette Point. The St. Lawrence River is also part of the St. Lawrence international Seaway. The shipping channel is located approximately 300 feet north of the GM facility.

4. HYDROGEOLOGIC INVESTIGATIONS

4.1 Introduction

The results of the hydrogeologic investigations described in the Site Operations Plan for the GM-CFD facility (RMT, 1985a) are presented in this section of the Remedial Investigation Report. A total of 44 monitoring wells were installed at 17 locations within and adjacent to the GM facility (Figure 4-1). The boring logs for the deepest well at each location can be found in Appendix A and the monitoring well construction details are in Appendix C. Construction problems were encountered with two wells, MW-13 and MW-21A. Both wells were replaced with the approval of the USEPA. Two additional wells (MW-11 and -21) required rehabilitation (removal of grout from well casing) prior to acceptance as functional monitoring wells. The rehabilitation procedure, approved by the USEPA, successfully removed the grout without damaging the well casing. Subsequent chemical analyses (Appendix J) showed no evidence of grout contamination in either well. The remaining wells were installed as described in the SOP, with minor changes approved by the USEPA. The development, field hydraulic conductivity, and water level measurements were carried out as described in the Site Operations Plan (RMT, 1985a). The results of the hydrogeological investigations are presented in Sections 4.2, 4.3, and 4.4 of this report.

All monitoring wells could not be sampled on either of the two specified rounds of sampling. One well (MW-19B) from the first round and 9 wells (MW-12, 13A, 13B, 17B, 19B, 20, 21, 26A and 27B) from the second round could not be sampled due to ice formation in the well casing or ice damage to the casing. One additional well (MW-15B) could

Figure 4-1

missing

not be sampled during the first round because of lack of water in the well. The monitoring wells were sampled according to the procedures described in the Site Operations Plan (RMT, 1985a). The results of the sampling are described in Section 4.3.3 of this report. Samples of ground water were split with NUS (EPA-FIT contractor) at 8 monitoring wells. The results from the EPA analyses were not available for inclusion in this report.

The Site Operations Plan (RMT, 1985a) included the sampling of private residential and public water supplies on Raquette Point, within the St. Regis Mohawk Reservation. An initial survey by the St. Regis Mohawk Health Services identified 36 private residential wells. These wells were sampled by RMT and the EPA FIT contractor. The HSL organic constituents from the EPA analyses were available for incorporation in this report. Four additional private residential wells and two private surface water users were added to the second round of residential sampling. The New York State Department of Health (DOH) sampled selected residential wells during the second round of sampling. The samples collected by RMT in the course of the RI were obtained according to the procedures specified in the SOP (RMT, 1985a). The results of the private residential and public water supply sampling are presented in Section 4.4 of this report.

4.2 Geologic Units

A total of 6 hydrogeologic units was defined beneath the GM-CFD Massena facility:

Upper glaciofluvial deposit

Glaciolacustrine/marine deposit

2.16

Glacial till

Lower glaciofluvial deposit

Glaciolacustrine deposit

Ogdensburg dolostone

The first 5 units consist of unconsolidated sediments deposited during the Quaternary Period as late Wisconsonian glaciers retreated across this region of North America (Clark, 1984). The upper glaciofluvial and glaciolacustrine/marine deposits are sandy and clay-rich deposits (respectively) left following the retreat of the final ice sheet. The sandy sediments may have been deposited as outwash south of the retreating ice margin, while the clayey sediments were deposited in proglacial lakes or beneath the Champlain Sea (MacClintock and Stewart, 1965; Clark and Karrow, 1983). The glacial till was deposited as the ice sheets advanced during Late Wisconsonian time. The lower glaciofluvial deposits were probably formed as either pro- or sub-glacial outwash which was buried by a subsequent ice advance. The glaciolacustrine deposit was formed in a proglacial lake setting which was covered by the Late Wisconsonian ice advance. The sixth unit, Ogdensburg dolostone, forms the bedrock surface over the entire study area.

Each unit is described in the following paragraphs. The division of the materials beneath the facility into these units is based on visual observation (color, fabric, structure), grain-size distributions, standard penetration tests (blow counts) and borehole correlations across the facility. The results of grain-size and laboratory permeability analyses and field hydraulic conductivity tests are summarized in Table 4-1. Appendix B includes the detailed laboratory

Table 4-1
Physical Soils Analyses Summary Table

Sample I.D.	#	Sampling Date	Sample Depth (feet)	Grain Size Analysis % Gravel	% Sand	% Silt	% Clay	Laboratory Hydraulic Conductivity* (cm/sec)	Field Hydraulic Conductivity (cm/sec)	Method**	Monitoring Well	Screened Geologic Unit***
MW-11	3	9-16-85	15.5-17	27.0	28.2	30.9	13.9	---	4.8×10^{-6}	1	11B	Till
MW-11	7	9-16-85	35-36.5	5.6	36.0	35.6	22.8	---	---	---	---	Till
MW-11	15	9-16-85	75-76.5	15.2	37.0	30.5	17.3	---	---	---	---	Till
MW-12	5	8-27-85	20-21.5	16.2	34.2	31.4	18.2	---	9.4×10^{-6}	1	12B	Till
MW-12	20	8-27-85	95-96.5	14.2	44.4	28.6	12.8	---	---	---	---	Sand lens in till
									6.8×10^{-4}	2	12	Dolostone
									1.3×10^{-4}	2	12A	Till
MW-13	3	8-15-85	15-16.5	5.5	32.0	42.7	19.8	---	2.0×10^{-5}	1	13B	Till
MW-13	7	8-16-85	35-36.5	24.1	32.5	26.9	16.5	---	2.0×10^{-6}	2	13A	Till
MW-13	15	8-21-85	75-76.5	16.9	37.2	28.2	17.7	---	---	---	---	Till
MW-14	3	11-21-85	55-56.5	14.9	28.5	37.4	19.2	---	---	---	---	Till
MW-14	5	11-21-85	65-66.5	15.1	33.2	32.7	19.0	8.0×10^{-9}	---	---	---	Till
MW-14	7	11-21-85	75-76.5	4.3	31.9	42.0	21.8	6.3×10^{-9}	---	---	---	Till
MW-14	9	11-21-85	85-86.3	21.2	33.3	28.2	17.3	---	---	---	---	Till
MW-14	12	11-21-85	100-100.7	20.8	32.0	28.8	18.4	---	---	---	---	Till
MW-14A	5	11-05-85	25-26.5	4.4	76.7	15.1	3.8	---	1.1×10^{-4}	2	14A	Lower Glaciofluvial
MW-14A	7	11-05-85	35-36	31.8	30.6	23.2	14.4	---	---	---	---	Till
									3.1×10^{-4}	1	14B	Glaciolacustrine/Marine and Till
MW-15A	5	11-07-85	20-21.5	7.2	35.5	34.8	22.5	9.9×10^{-9}	---	---	15B	Till
MW-15A	7	11-08-85	30-31.5	8.6	45.3	32.4	13.7	---	3.2×10^{-4}	2	15A	Lower Glaciofluvial
									1.0×10^{-3}	2	15	Dolostone
MW-16	2	11-06-85	50-51.5	10.9	38.5	32.8	17.8	2.2×10^{-8}	---	---	---	Till
MW-16	4	11-06-85	60-61.5	3.9	38.8	34.4	22.9	6.1×10^{-9}	---	---	---	Till

* Laboratory permeability tests were run on undisturbed samples in a pressure permeameter.
** Method used to determine hydraulic conductivity: 1) Bouwer and Rice (1976); 2) Hvorslev (1951).
*** If well is screened in more than one geologic unit, the underlined unit is the one for which grain size analysis was conducted.

Table 4-1 (cont'd)
Physical Soils Analyses Summary Table

Sample I.D.	#	Sampling Date	Sample Depth (feet)	Grain Size Analysis % Gravel	% Sand	% Silt	% Clay	Laboratory Hydraulic Conductivity* (cm/sec)	Field Hydraulic Conductivity* (cm/sec)	Method**	Monitoring Well	Screened Geologic Unit***
MW-16	6	11-06-85	70-71.5	4.9	38.5	35.5	21.1	5.0×10^{-9}	---	---	---	Till
MW-16	7	11-06-85	75-76.5	25.6	28.2	23.5	22.7	---	---	---	---	Till
MW-16A	3	11-04-85	35-36.5	1.3	25.3	52.8	20.6	---	1.2×10^{-4}	2	16A	Till
MW-16B	10	10-16-85	18-18.5	47.8	40.3	11.9	0.0	---	2.0×10^{-4}	1	16B	Glaciolacustrine/Marine and <u>Lower Glaciofluvial</u>
MW-17	3	10-23-85	10-11.5	0.0	1.0	66.2	32.8	---	---	---	---	Glaciolacustrine/Marine
MW-17	8	10-23-85	35-36.5	24.9	34.1	27.8	13.2	---	---	---	---	Till
MW-17	13	10-23-85	60-61.5	7.5	36.8	37.3	18.4	5.4×10^{-9}	---	---	---	Till
MW-17	15	10-25-85	70-71.5	8.4	36.7	35.5	19.4	3.6×10^{-9}	---	---	---	Till
MW-17	18	10-28-85	85-86.5	6.1	36.9	37.2	19.8	6.2×10^{-9}	---	---	---	Till
									2.2×10^{-4}	2	17	Dolostone
MW-18	2	10-18-85	5-6.5	13.8	40.9	34.7	10.6	---	---	---	---	Upper Glaciofluvial
MW-18	4	10-18-85	15-16.5	4.2	37.8	43.5	14.5	---	6.6×10^{-4}	1	18B	<u>Till</u> and Upper Glaciofluvial
MW-18	8	10-18-85	35-36.5	11.4	34.5	33.7	20.4	---	---	---	---	Till
									6.0×10^{-4}	2	18	Dolostone
MW-18	11	10-18-85	50-51.5	10.2	34.7	35.1	20.0	5.4×10^{-9}	---	---	---	Till
MW-19	4	10-07-85	15-16.5	20.1	34.0	32.0	13.9	---	---	---	---	Till
MW-19	8	10-07-85	35-36.5	9.7	37.0	34.3	19.0	---	---	---	---	Till
MW-19	12	10-09-85	55-56.5	12.8	35.6	33.7	17.9	---	---	---	---	Till
									6.5×10^{-4}	2	19	Dolostone
MW-20	4	9-26-85	15-16.5	11.2	37.3	34.3	17.2	---	1.6×10^{-4}	1	20B	<u>Till</u> and Upper Glaciofluvial
MW-20	8	9-26-85	35-36.5	16.0	33.5	32.2	18.3	---	1.0×10^{-4}	2	20A	Till
MW-20	12	9-26-85	55-55.8	21.1	36.2	28.7	14.0	---	---	---	---	Till
MW-21	5	9-24-85	20-21	23.5	35.4	28.6	12.5	---	1.3×10^{-4}	1	21B	Till

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* Laboratory permeability tests were run on undisturbed samples in a pressure perneameter.
** Method used to determine hydraulic conductivity: 1) Bouwer and Rice (1976); 2) Hvorslev (1951).
*** If well is screened in more than one geologic unit, the underlined unit is the one for which grain size analysis was conducted.

Table 4-1 (cont'd)
Physical Soils Analyses Summary Table

Boring No.	Sample No.	Sampling Date	Sample Depth (feet)	Grain Size Analysis % Gravel	% Sand	% Silt	% Clay	Laboratory Hydraulic Conductivity* (cm/sec)	Field Hydraulic Conductivity (cm/sec)	Method**	Monitoring Well	Screened Geologic Unit***
MW-21	11	9-24-85	50-51.5	2.9	38.6	36.1	22.4	6.3×10^{-9}	---	---	---	Till
MW-21	13	9-24-85	60-61.5	6.4	25.6	34.0	34.0	4.2×10^{-9}	---	---	---	Till
MW-21	15	9-24-85	70-71.5	11.7	37.2	34.6	16.5	1.8×10^{-8}	---	---	---	Till
									2.7×10^{-5}	2	21	Dolostone
									4.7×10^{-6}	1	22B	Fill and Till
MW-23A	5	8-15-85	20-21.5	0	8.3	21.0	70.7	---	7.4×10^{-7}	1	23B	Glaciolacustrine/Marine
									1.0×10^{-7}	2	23A	Till and Glaciolacustrine/ Marine
MW-24A	7	8-22-85	30-31.5	1.5	17.2	64.9	16.4	---	3.5×10^{-7}	2	24A	Till and Lower Glaciofluvial
									4.0×10^{-6}	1	24B	Till and Glaciolacustrine/ Marine
MW-25A	4	9-04-86	15-16.5	4.8	34.2	44.9	16.1	---	1.1×10^{-5}	1	25B	Till
MW-25A	6	9-04-85	25-26.5	0.7	76.9	18.1	4.3	---	2.7×10^{-5}	2	25A	Lower Glaciofluvial
MW-26A	9	10-18-85	16-18	3.3	27.9	49.2	19.6	---	---	---	---	Till
MW-26A	15	10-18-85	38-40	11.7	39.6	32.5	16.2	---	3.0×10^{-5}	2	26A	Till
MW-27A	3	8-29-85	10-11.5	15.0	33.3	31.9	19.8	---	4.4×10^{-5}	1	27B	Till
MW-27A	7	8-29-85	30-31.5	0.2	31.7	42.6	25.5	---	---	---	---	Lower Glaciofluvial
MW-27A	8	8-29-85	35-36.5	15.7	41.6	30.2	12.5	---	3.6×10^{-5}	2	27A	Lower Glaciofluvial

* Laboratory permeability tests were run on undisturbed samples in a pressure permeameter.
** Method used to determine hydraulic conductivity: 1) Bouwer and Rice (1976); 2) Hvorslev (1951).
*** If well is screened in more than one geologic unit, the underlined unit is the one for which grain size analysis was conducted.

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reports for grain size analyses. The geologic logs for monitoring wells and soil/waste borings are in Appendix A and C, respectively.

Rising head, single well response tests were conducted to determine the in situ hydraulic conductivity of the various geologic deposits in which the wells are completed. The determination of hydraulic conductivity is based on the standard methods described by Hvorslev (1951) or Bouwer and Rice (1976), depending on which method is most appropriate for the type of well construction and the hydrogeologic conditions at each well or piezometer. Results of single well response tests are contained in Appendix G. The laboratory hydraulic conductivity tests were performed on a flexible-wall pressure permeameter using procedures outlined in the Site Operations Plan (RMT, 1985a). The test results can be found in Appendix F.

The upper glaciofluvial deposit consists of predominantly silty fine sand up to 13 feet thick. It is found at the ground surface over a limited portion of the GM facility. It was observed in samples from borings B-245, B-246, MW-11, MW-18, and MW-20; and in earlier (Dames & Moore, 1981a, 1981b) boring logs for MW-9, MW-5, MW-103, and MW-110. The upper glaciofluvial deposit was also observed east of the unnamed tributary and to the north of well cluster MW-17 by Catlin and others (1983). Grain size analysis on one sample from the upper glaciofluvial deposit indicates a composition of 14% gravel, 41% sand, 35% silt, and 10% clay. No lab permeability or In situ hydraulic conductivity data were available for the upper glaciofluvial deposit.

The glaciolacustrine/marine sediments are a slightly silty clay unit that is up to 24 feet thick. It is found at or near the ground surface in a band paralleling the St. Lawrence River. Grain-size analyses of two samples of this material had silt and clay contents of 88 to 99 percent. Hydraulic conductivity values for single well response tests in wells completed in the glaciolacustrine/marine deposit ranged from 1.0 x 10^{-7} cm/s to 7.4 x 10^{-7} cm/s (Table 4-1). The high hydraulic conductivity is probably due to horizontal bands or lenses of silt within this unit. No laboratory hydraulic conductivity analyses were conducted on samples from this deposit.

The glacial till is a massive, dense, silty to sandy grey till. East of the plant, in the area of the Industrial Landfill and beneath the East Disposal Area, the unit is divided into 30 feet of brown till overlying grey till. The brown till may represent a thick weathering profile of the grey till. The remainder of the site is underlain by the grey till.

Grain size analyses were conducted on 43 samples from the glacial till. The till consists of 10 to 25 percent clay, 20 to 55 percent silt, 24 to 38 percent sand, and 1 to 27 percent gravel. Laboratory vertical hydraulic conductivities of 9 till samples collected between the depths of 20 to 87 feet ranged from 3.6 x 10^{-9} to 2.2 x 10^{-6} cm/s. The predominantly horizontal hydraulic conductivity values for in situ single well response tests in wells completed only within the upper 40 feet of the till ranged from 2.0 x 10^{-6} cm/s to 1.3 x 10^{-4} cm/s (Table 4-1). The geometric mean of these eleven field values is 2.7 x 10^{-5} cm/s. Dames & Moore (1982a and 1982b) field test data covered a range similar to the RI data, 8.9 x 10^{-5} to 5.0 x 10^{-6} cm/s. The difference between the laboratory and the field data may be due to anisotropy resulting from the presence of very thin sandy seams or fractures. It may also be due to the presence of a less permeable till below an elevation of 130 to 160 feet.

The lower glaciofluvial deposit is typically a silty fine sand within the till. This unit is encountered north and northeast of the plant, beneath the North and East Disposal Areas and beneath the Industrial Landfill.

The unit is differentiated from the till by grain size distribution, sorting and structure. Two submembers of this unit were observed during the course of the RI: a sandy member that averages 16% gravel, 56% sand, 20% silt, and 9% clay; and a less widespread silty member that averages 1% gravel, 25% sand, 54% silt, and 21% clay. The differences are probably the result of changes in depositional environments within a fluvial setting. Field hydraulic conductivity values range from 3.2×10^{-4} cm/s to 3.5×10^{-7} cm/s (geometric mean of 9.2×10^{-5} cm/s) for the sandy member of this unit. Field tests performed by Dames & Moore (1982a and 1982b) ranged from 5.9×10^{-4} cm/s to 1.1×10^{-5} cm/s whenever their monitoring wells intersected this unit.

The glaciolacustrine deposit is a varved silt and clay, up to 20 feet thick, underlying the till northeast of the plant. The unit was described in previous investigations (Dames & Moore, 1982) but neither the work performed for the Mohawk Tribal Council (Catlin and others, 1983) or the work conducted during the RI encountered this unit. No soil analyses or hydraulic conductivity data were obtained during the Remedial Investigation. Four Dames & Moore wells (1982b) that intersect this unit were reported to yield field horizontal hydraulic conductivity values of 3.4×10^{-5} cm/s to 1.1×10^{-6} cm/s. The varved nature of the sediments makes it likely that the vertical hydraulic conductivity is several orders of magnitude less than the measured horizontal conductivities.

The bedrock beneath the facility is part of the Paleozoic Ogdensburg dolostone (Trainer and Salvas, 1962; Van Diver, 1971; MacClintock and Stewart, 1965; Wilson, 1976). The literature describes the unit as black to grey dolomite or magnesium limestone or sandy dolomite. Secondary calcite and gypsum deposition is common in vugs and along fractures. Locally, the gypsum can be found in strata or beds up to 5 feet thick (Trainer and Salvas, 1962). The Ogdensburg is essentially flat-lying and up to 500 feet thick near the Town of Massena (Trainer and Salvas, 1962). Joints are common throughout the area and many are enlarged by the dissolution of the rock. Solution openings have been reported to depths of 50 feet below the bedrock surface (Trainer and Salvas, 1962).

Eleven monitoring wells were completed in the bedrock. Core samples from the upper 15 feet of the dolostone consisted predominantly of dark grey, finely crystalline, fractured dolomite. Small vugs (1-5 mm) are numerous in many core samples and are often filled with calcite or gypsum. Carbonate precipitation also fills or coats many of the fractures. Occasional large vugs, up to one to two inches in diameter, are found. Very fine pyrite crystals are found disseminated through some samples.

Besides the fine-grained dolomite, small amounts of sandy textured dolomite, dolomitic shale, shale, and noncarbonate sand are found in some samples. Layers of intraclasts of dolomite, limestone, or shale occur occasionally, and contorted bedding and algal mat-like structures were observed in some of the samples.

Rock quality designations for core samples ranged from 0.0 for run 1 in MW-14 to 0.94 in run 2 of MW-21. The average RQD for 21 core runs was 0.61. Hydraulic conductivity values for 8 single-well response tests in six bedrock wells completed during the RI ranged from 1.0×10^{-5} cm/s to 2.7×10^{-5} cm/s (Table 4-1) with a geometric mean of 3.4×10^{-4} cm/s. Dames & Moore (1982a) reported single-well test results of 7.7×10^{-5} and 2.1×10^{-4} cm/s for wells MW-6B and MW-105, respectively. Trainer and Salvas (1962) summarize 23 aquifer tests from the Massena-Waddington area. The hydraulic conductivity values from these tests range from 7×10^{-5} cm/s to 7×10^{-2} cm/s with a median value of 1×10^{-2} cm/s. Specific storage coefficient values of 5 of these aquifer tests ranged from 3.1×10^{-5} to 6.1×10^{-7} 1/ft.

4.5 Raquette Point Water Supplies

4.5.1 Water Use

The St. Regis Mohawk Health Services conducted a survey of residents on Raquette Point during the autumn of 1985. They identified approximately 190 residents who live on the Point (Figure 4-13). Five commercial establishments and one school with water supplies were also identified.

The survey attempted to determine the source of water for each residence on Raquette Point. Not all residents were covered in the survey; therefore, the following numbers are only estimates. The source of potable water for about 15 percent of the Raquette Point residents was not determined.

The St. Lawrence River is used by approximately 10 percent of the residents. A homeowner typically extends a 1- to 2-inch diameter pipe several tens of feet into the river and draws the water into the home with a jet-pump or centrifugal pump.

Most residents (55%), the school, and all five commercial establishments use ground water as a potable water supply. A total of 36 wells were sampled in the course of the RI (Table 4-5). All the residential water supply wells identified by the Health Service were sampled at least once. Both hand dug, stone-lined wells and steel-cased drilled wells are used on Raquette Point. Well depths, where known, ranged from 8 to 225 feet. The wells draw

Figure 4-13

missing

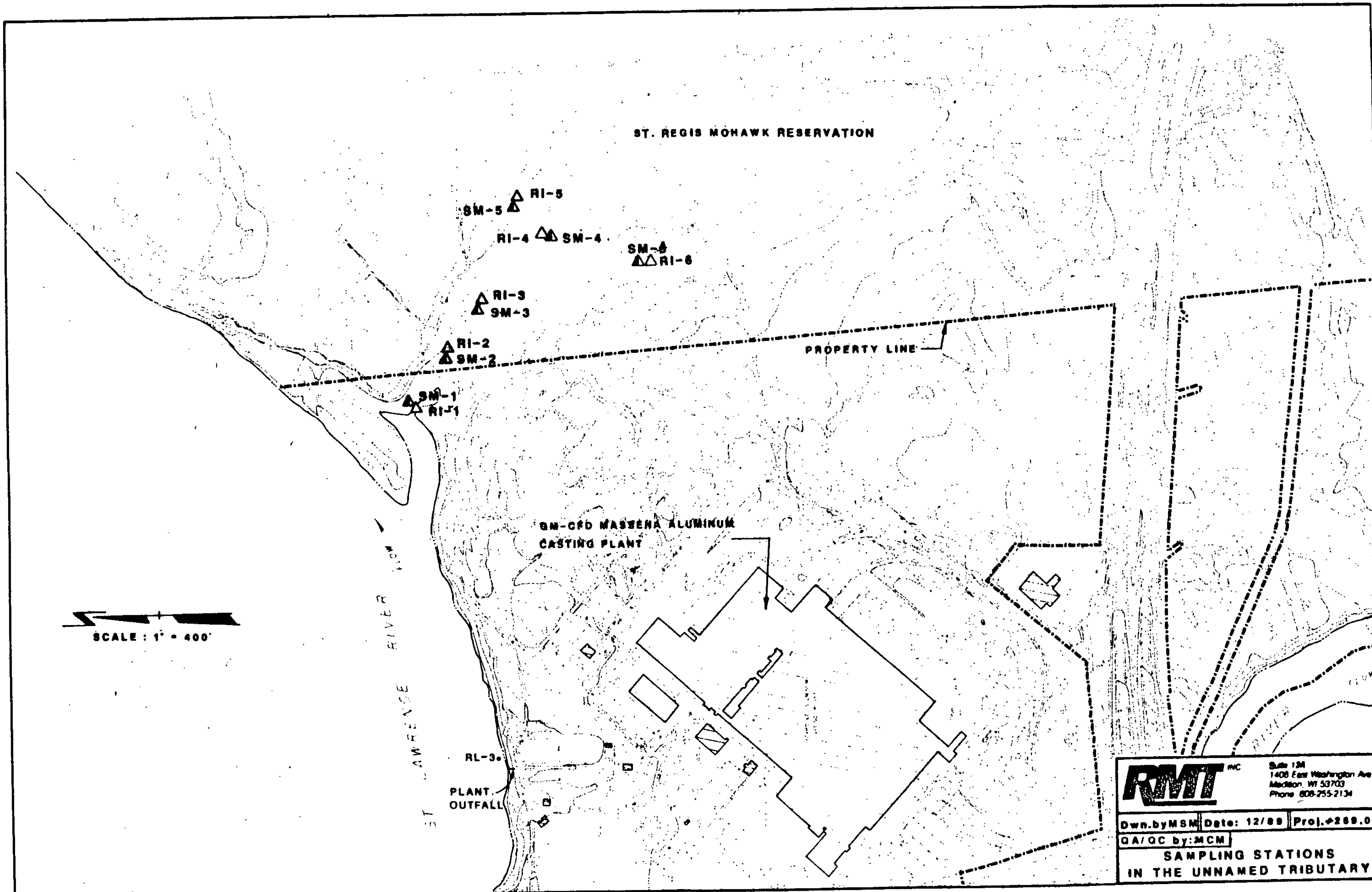
Table 4-5

Summary of Residential Water Supplies Sampled on Raquette Point

Well #	Well Owner	Well Type	Well Depth	Comments
IRR-1	Akwesasne Tobacco Shop	drilled	?	H_2S odor
2	Ahnawate Diner	drilled	53	---
3	Ahnawate Corner Store	?	?	iron odor
4	Akwesasne Notes/Indian Times Loren Thompson, Peter Blue Cloud	?	?	---
5	Akwesasne Freedom School	drilled	70	H_2S odor
6	Randall Jacobs Garage	drilled	58	H_2S odor, greenish tint
7	Jim, Kenneth & George White	dug	17	---
8	Paul Thompson	drilled	70	faint H_2S odor
9	Gladys Gray (Joe Swamp)	drilled	89	---
10	Leslie Thompson	drilled	?	---
11	Ida Ransom	drilled	55	---
12	Tony Cole	?	?	H_2S Odor black color
13	Gary Cole	?	?	strong H_2S odor black color
14	Jack Tarbell	?	?	---
15	Martin Jock	drilled	60	---
16	Newton LaFrance	spring	12	---
17	Angus Dell	spring	6	brown tint, suspended solids
18	Angus Dell	drilled	65	H_2S odor
19	Freeman LaZore	dug	28	iron odor and color
20	Aron Oakes	spring	8	---
21	Mike LaFrance	drilled	200	strong H_2S odor
22	Randall Jacobs	drilled	118	strong H_2S odor
23	Tom Laughing	dug	30	---
24	John Cole	drilled	130	---
25	Richard Skidders	drilled	30	---
26	Arthur Cook	drilled	90	---
27	Akwesasne Resort (Stewart White)	?	?	---
28	Jesse Dlabo	drilled	52	---
29	Francis Herne	drilled	60	H_2S odor
30	Larry Thompson	dug	18	---
31	Angus Laughing	drilled	225	H_2S odor
32	Carl Tarbell	drilled	?	---
33	Harry Thompson	dug	8	---
34	Julius Cook	(St. Lawrence River)	---	---
35	Tony Barnes	(St. Lawrence River)	---	---
36	Philip Terrance	drilled	85	H_2S odor
37	Aron Oakes	drilled	108	H_2S odor
38	Marlon LaFrance	dug	7	---

water from glacial deposits or the Ogdensburg dolostone. The majority of wells are equipped with jet-pumps; however, some drilled wells are equipped with submersible pumps and some dug wells are equipped with hand-pumps or buckets.

A public water system is operated by the St. Regis Mohawk Reservation. The system began operation in 1977. Water is drawn from the St. Lawrence River, immediately downstream from the mouth of the Raquette River. The water passes through diatomaceous earth filters and is chlorinated before it enters the water distribution system. Approximately 70,000 gallons of water per day are supplied to about 500 residents in the western portions of the Reservation, including some 20% of the residents on Raquette Point. Influent water and the filtered and chlorinated finished water were sampled in November 1985 and January 1986 (Appendix K). The filters are periodically backflushed into a sludge settling lagoon. This sludge was sampled in November 1985. A second water supply system drawing water from the St. Lawrence River serves the village of St. Regis, Quebec, Canada. The intake is located several miles downstream from the GM facility and was not sampled.



ST. REGIS MOHAWK RESERVATION
RI-5
SM-5
RI-4
SM-4
SM-6
RI-6
RI-3
SM-3
RI-2
SM-2
PROPERTY LINE
SM-1
RI-1
GM-CFD MASSENA ALUMINUM CASTING PLANT
SCALE : 1" = 400'
ST. LAWRENCE RIVER
RL-3
PLANT OUTFALL
RMT INC
Suite 134
1406 East Washington Ave
Madison, WI 53703
Phone 608-255-2134
Dwn.by MSM
Date: 12/89
Proj.#289.07
QA/QC by: MCM
SAMPLING STATIONS IN THE UNNAMED TRIBUTARY

FIGURE 5-4

APPENDIX A

BORING LOGS FOR MONITORING WELLS INSTALLED DURING THE RI

(2-81)

2.31

LOG OF TEST BORING RESIDUALS MANAGEMENT TECHNOLOGY, INC.	
PROJECT: GM-CFD MASSENA RI/FS	JOB NO.: 269.07
LOCATION: MASSENA, NY	BORING NO.: MW-19
DRILLED BY: EMPIRE SOILS INVESTIGATIONS	SURFACE ELEV.: 181.8' (MSL)
LOGGED BY: R.BUSH, J.HAMMOND, B.REHM	
DATE: 7 OCTOBER 1985	SHEET NO.: 1 of 2

SAMPLE No.	Type	Recovery (in)	Moisture	N	Depth	VISUAL CLASSIFICATION and Remarks
1	SS	17	Moist	43	0–5	Olive-grey silt, some clay, little f. to c. sand, little f. gravel. tr. c. gravel.
2	SS	15	Wet	60	5–10	Dark grey silt, some clay some f. sand, tr. m. to c. sand, tr. f. gravel.
3	SS	17	Damp	78	10–15	Dark grey silt, some clay tr. f. to c. sand, tr. f. gravel.
4 GS	SS	16	Wet	73	15–20	Dark grey silt, little clay some f. to c. sand, tr. f. gravel.
5	SS	17	Moist	58	20–25	Dark grey silt and clay, tr. f. to c. sand, tr. f. to c. gravel.
6	SS	3	Wet	121	25–30	Dark grey silt and clay, with f. gravel, little f. to c. sand.
7	SS	18	Damp	137	30–35	Dark grey silt with clay, tr. f. to c. sand, tr. f. gravel.
8 GS	SS	18	Damp	83	35–40	Dark grey silt, some clay, some f. sand, tr. m. to c. sand, tr. f. gravel.

GENERAL NOTES	WATER LEVEL OBSERVATIONS
START: 7 OCT. 85	WHILE DRILLING: 16.0 ft. BGS
COMPLETE: 9 OCT 85	UPON COMPLETION:
RIG: CME 75	TIME AFTER DRILLING:
CREW CHIEF: BUSH or WARNER	DEPTH OF WATER:
DRILLING METHOD: 6-in spin	DEPTH OF CAVE-IN:

J.H.O.W. 10/86

F-204 (cont'd.)

LOG OF TEST BORING
RESIDUALS MANAGEMENT TECHNOLOGY, INC.

PROJECT: GM-RI/FS	JOB NO.: 269.07
LOCATION: MASSENA, NY	BORING NO.: MW-19
DRILLED BY: ESI	SURFACE ELEV.: 181.8' (MSL)
LOGGED BY: R.BUSH, J.HAMMOND, B.REHM	
DATE: 7-9 OCTOBER 1985	SHEET NO.: 2 of 2

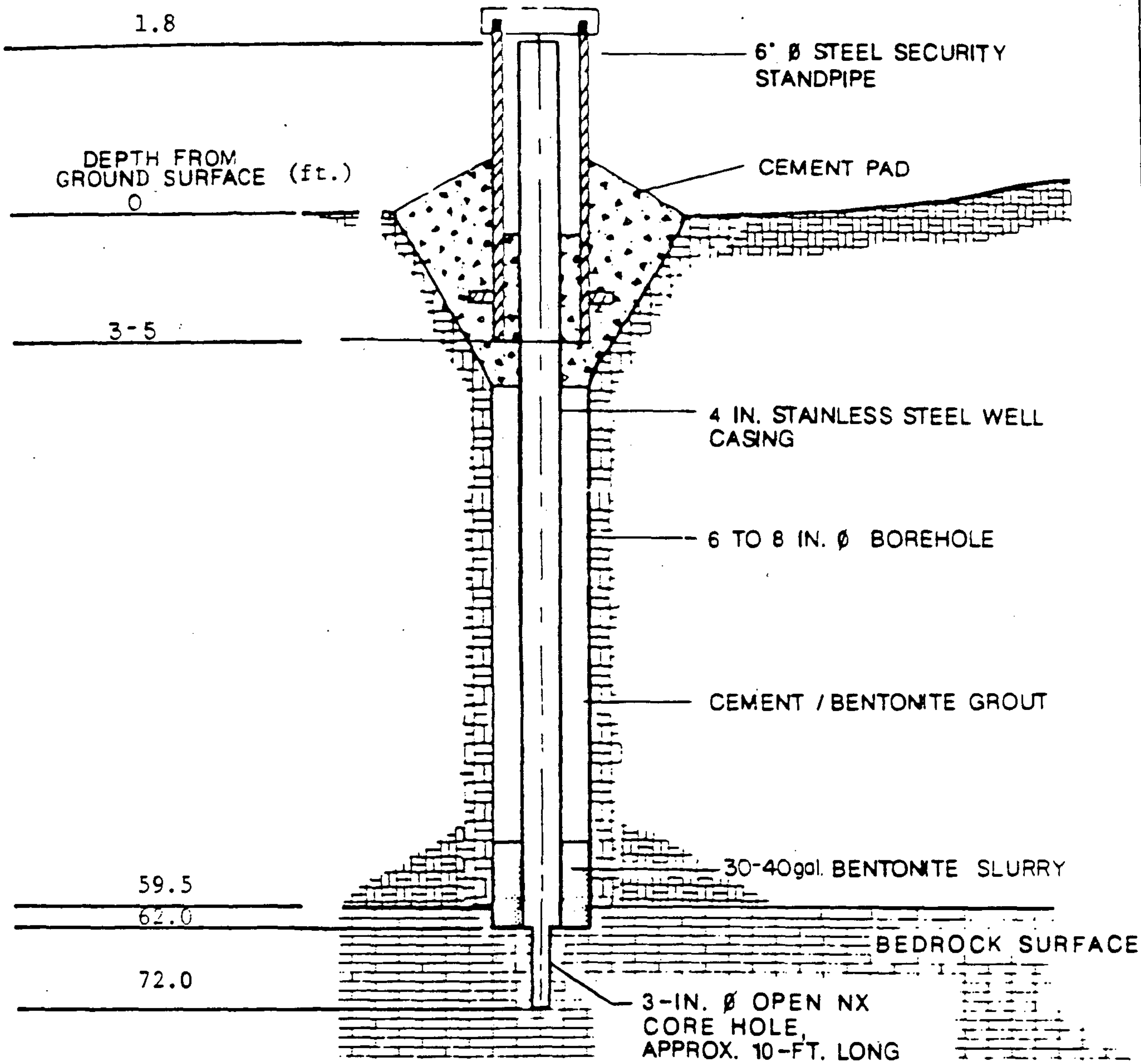
SAMPLE No.	Type	Recovery (in)	Moisture	N	Depth	VISUAL CLASSIFICATION and Remarks
9	SS	18	Damp	92		As above.
10	SS	18	Damp	71	45	Dark grey silt with clay, little f. sand, tr. m. to c. sand.
11	SS	7	Moist	77	50	As above.
12 GS	SS	17	Damp	122	55	Dark grey silt, some clay, some f. sand, tr. m. to c. sand.
--	NX	24	RQD= 0.57	--	60	1: Dark grey coarse, granular, calcareous dolomite. Many small vugs with gypsum & calcite pptn.
	NX	112	ROD= 0.75		65	2: Black to dk grey dolomitic shale with zones of very fine textured dolomite, occ. very fine disseminated pyrite. Zones of contorted bedding & reworked fragments of f. textured limestone. Fracture w/calcite pptn. at 67.15'. Large vug w/calcite, gypsum, and very fine pyrite ar 68.00'.
	(21+ fractures)				70	
						END OF BORING AT 72.00'
					75	
					80	
					85	

APPENDIX C

WELL CONSTRUCTION DIAGRAMS FOR RI MONITORING WELLS

GM-CFD Massena
MW-19
Ground Elevation: 181.8 (ft, MSL)
Date: 10/7/85

BEDROCK PIEZOMETER



MONITORING WELL CONSTRUCTION DETAILS

J Haw 1/9/86

RMT

Dwn by	CLG
Date	12/20/85
Proj #	269.07

Reference
3.1

STATE OF NEW YORK
DEPARTMENT OF CONSERVATION
WATER RESOURCES COMMISSION

GROUND-WATER RESOURCES OF THE MASSENA-WADDINGTON AREA, ST. LAWRENCE COUNTY, NEW YORK
With Emphasis on the Effect of Lake St. Lawrence on Ground Water

by
FRANK W. TRAINER and EDWARD H. SALVAS
Geologists, U. S. Geological Survey

[illegible]
[illegible] GEOLOGICAL SURVEY
[illegible]
[illegible] AUTHORITY OF THE STATE OF NEW YORK [illegible]
[illegible]
NEW YORK WATER RESOURCES COMMISSION

GEOLOGY

The Massena-Waddington area is in the lowland which separates the Adirondack Mountains from the Canadian Shield. This lowland is underlain predominantly by lower Paleozoic sedimentary rocks. In the Massena-Waddington area the rocks are chiefly flat-lying or gently dipping strata of Cambrian and Ordovician age. Precambrian crystalline rocks are exposed at a few places in the southwestern part of the area. The bedrock, covered nearly everywhere by glacial drift, is exposed only locally in stream beds and at a few other places.

Consolidated Rocks

Table 2 summarizes the succession of consolidated rocks in the Massena-Waddington area and in the adjacent region to the south, and plate 3 shows the inferred distribution of bedrock in the area. The classification of rock units used in the mapping is the simplest consistent with hydrologic conditions; it has been somewhat generalized from the classification of the earlier workers because the scarcity of exposures and detailed well logs prevents detailed mapping of the bedrock in the Massena-Waddington area.

Precambrian Crystalline Rocks

Crystalline rocks of Precambrian age underlie the entire area, but they are everywhere overlain by Paleozoic rocks except at one locality west of Potsdam. At and beyond the southern edge of the area Martin (1916) and Reed (1934) mapped these rocks in the Canton and Potsdam quadrangles (1:62,500), respectively, and described them as gneiss and crystalline limestone (marble) with subordinate granitic and mafic igneous rocks. The crystalline limestone and much of the gneiss are metamorphosed sedimentary rocks referred to the Grenville series; most of the other rocks are intruded into them and hence are younger.

Reddish granite gneiss is exposed at the southern edge of the area about 5 miles west of Potsdam (pi. 3). What may be the same rock overlies dark-green crystalline rock in well 440-505-2. Well 438-503-1, about 4 miles southwest of Potsdam, penetrated 236 feet of soft red sandstone (probably Potsdam sandstone) and 217 feet of underlying white limestone (probably of Grenville age). Several other wells in the southern part of the area are reported to have penetrated crystalline rocks. A deep test hole (456-452-3) drilled at Massena about 1900 reportedly penetrated granite after passing through 500 feet of limestone and several hundred feet of yellow, red, and white sandstone. None of the well records provides information about the structure of the crystalline rocks of the Massena-Waddington area, and, so far as the writers are aware, no other data concerning their structure are available.

Paleozoic Rocks

Lower Paleozoic rocks, chiefly dolomite with subordinate limestone and sandstone, underlie nearly the entire Massena-Waddington area. About two-thirds of the area is underlain by Ordovician dolomite and limestone (pi. 3). A broad band of Cambrian or Ordovician sandstone, with some interbedded dolomite, borders the dolomite on the southeast and south. Despite the scarcity of exposures the gross lithologic character of the rocks is

Table 2.--Consolidated rocks in the Massena-Waddington area, St. Lawrence County, New York

Age	Rock units in northern St. Lawrence Co., N. Y. (Martin, 1916; Chadwick, 1919; Reed, 1934)	Rock units in Ontario (Wilson, 1946a)		Rock units in the Massena-Waddington area as used in this report
Lower Ordovician		Chazy	St. Martin formation Rockcliffe formation	Chazy group
	Ogdensburg dolomite Bucks Bridge mixed beds	Beek-mantown	Oxford formation March formation	Beekmantown group (predominantly dolomite with minor sandstone, shale, and gypsum beds)
Lower Ordovician or Upper Cambrian	Heuvelton sandstone Theresa sandstone Potsdam sandstone		Nepean sandstone	Theresa dolomite (predominantly sandstone or calcareous sandstone) Potsdam sandstone
Precambrian	Grenville series and other crystalline rocks		Grenville series and other crystalline rocks	Crystalline rocks

fairly well known because hundreds of wells penetrate them; few detailed records concerning the character of the rocks penetrated have been preserved, however. Relatively few wells are deep enough to pass completely through these rocks. The thickest section known at a single place is at Massena, where well 456-452-3 reportedly penetrated 500 feet of limestone and several hundred feet of sandstone before reaching granite. Wilson (1946a, Map 852A, section ABC) suggests a thickness of 500-600 feet of Paleozoic rocks near Cornwall.

Potsdam sandstone

Although names for exposures near Potsdam the Potsdam sandstone is not well exposed there and, so far as the writers are aware, is not exposed anywhere in the Massena-Waddington area. It is the lowermost Paleozoic formation around the base of the Adirondacks. The name Potsdam, was long applied to Cambrian sandstone immediately overlying crystalline rocks in the region extending from New York into the midwestern States, but is now restricted to the basal Paleozoic sandstone in part of New York and southern Canada.

In its type area the Potsdam sandstone is a fine- to medium-grained quartz sandstone which is commonly pebbly at its base. It is typically reddish-brown because of the presence of iron oxide (hematite) as a cementing agent; beds of white sandstone and gray sandstone are also present, however. The red sandstone was formerly used extensively in buildings and pavements in the village of Potsdam.

The Potsdam sandstone is about 200 feet thick in St. Lawrence County (Fisher, 1956, p. 325). It has been found in at least one well (438-502-1) in the Massena-Waddington area, near Potsdam, and perhaps also in the deep well (456-452-3) at Massena.

Theresa dolomite

The Theresa dolomite, a series of transitional beds between the Potsdam sandstone and the dolomitic rocks of the Beekmantown group, is arbitrarily separated from the Potsdam sandstone, where both formations are present, at the lowermost dolomite layer in the sequence. The Theresa dolomite is about 300 feet thick near its type locality in Jefferson County, southwest of St. Lawrence County, but is probably somewhat thinner in the Massena-Waddington area. In this area the Theresa dolomite consists of white, gray, or brown sandstone, in part calcareous, with subordinate dolomite and shale. It is the uppermost Paleozoic formation in about a fifth of the area. At several places in the area the older workers recognized a 20-foot bed of white sandstone (Heuvelton sandstone of Chadwick, 1915) at the top of and conformable with the Theresa beds, and unconformably underlying the next higher rocks. In addition, Chadwick (1915; 1919, p. 28) recognized the Bucks Bridge mixed beds, a series of strata that are sandy in the lower part and dolomitic in the upper part, which lie between the Heuvelton sandstone and the Ogdensburg dolomite (table 2). The upper part of the Bucks Bridge mixed beds contains fossils of lower Beekmantown age. Recent work (Fisher, D. W., New York State Paleontologist, oral communication, 1960) indicates, however, that in many places the contact between the Theresa dolomite and rocks of Beekmantown age is difficult to recognize, and suggests that the relation between the rocks may be a gradational one. For these reasons, and because there are relatively few exposures to permit detailed mapping of the stratigraphic units, the writers mapped the Theresa dolomite (pl. 3) to include the Meuvelton sandstone and lower sandy part of the Bucks Bridge mixed beds of Chadwick (1915).

Beekmantown group

The rocks mapped as the Beekmantown group (pl. 3) consist of the upper part of the Bucks Bridge mixed beds of early Beekmantown age; and of the Ogdensburg dolomite of Chadwick (1915), which is essentially equivalent to Division D of the classic Beekmantown section in the Champlain Valley.

The rocks of the Beekmantown group are largely black dolomite and gray dolomite containing subordinate limestone, sandstone, and shale. Pyrite is widely distributed through the rock as disseminated crystals. Gypsum is common, chiefly in small veins and thin strata, but locally it has been found in beds 3 to 5 feet thick.

Rocks of the Beekmantown group are the uppermost bedrock in about two-thirds of the Massena-Waddington area (pl. 3). The dolomite is 500 feet thick at Massena (well 456-452-3) and may be thicker near its contact with the rocks of the Chazy group. Well 451-451-3 (see log, table 9 and fig. 28) penetrates 200 feet of dolomite and subordinate sandstone believed to be entirely in the Beekmantown group.

Chazy group

The Chazy rocks were mapped (pl. 3) on the basis of well logs. In contrast to the underlying Beekmantown rocks they consist chiefly of limestone and sandstone containing some dolomite and shale. Chazy limestone and sandstone in several test holes on Barnhart Island appear to have a total thickness of 50-100 feet; the log of well 459-451-8, at the north end of Long Sault Dam, suggests a thickness of about 80 feet.

Structure

The bedrock underlying the Massena-Waddington area forms part of the southeast limb of a basin, the greater part of which is in Ontario and Quebec (Wilson, 1946a, Map 852A). The basin is elongated toward the northeast. It is about 100 miles long and about 70 miles wide, extending northwestward from the foothills of the Adirondack Mountains to the Canadian Shield.

Wherever the writers observed the Paleozoic rocks in the Massena-Waddington area they are flat-lying or dip 5° or less. In most exposures where the beds are not flat-lying the strike of the bedding is northeast and the dip northwest; in a few places the beds strike northwest and dip northeast or southwest. In the Canton quadrangle, near and south of the southern edge of the Massena-Waddington area, Chadwick (1919, p. 9-10 and geologic map) found that the structure is characterized by folds which strike northeast and by irregular folds, including small domes, which trend in other directions. All these data, together with the trends of formation contacts north of the St. Lawrence River (Wilson, 1946a map 852A), indicate that in general the strata in this area dip gently northwestward in a homoclinal structure interrupted by tracts of flat-lying or gently folded rocks.

Wilson (1946a, p. 33-35, map 852A, and fig. 3) mapped numerous faults north of the St. Lawrence River, most of them in the northern part of the lowland near the edge of the Canadian Shield. The faults, which are of the tensional type, are concealed in most places but their presence is suggested by the Irregular distribution of the rocks. They strike along two dominant trends, northeast or east and northwest. Near Ottawa the faults are known to have steep dips.

One fault near the St. Lawrence River, if extended southeast, would enter New York about 3 miles southwest of the Massena Power Canal. Hydrologic data suggest that a fault may cut the bedrock in this general part of the Massena-Waddington area. The presence of highly mineralized water and natural gas in a well about 3 miles west-southwest of the north end of the Power Canal is reasonably explained by postulating the presence of a fault trap (see chapter describing the occurrence of ground water in isolated reservoirs in the bedrock, p. 40).

A fault zone about 200 feet wide was uncovered during excavation for the Snell Lock (U. S. Army, 1958b, p. 33). The fault zone strikes N 56°E; it is thought to dip vertically and to have a downthrow of 35 feet to the southeast.

Joints are common in all the consolidated rocks in this area. In exposures at the surface they are most conspicuous in dolomite because of enlargement by solution. However, sections exposed in several quarries in dolomite show that the joints have not been widened appreciably below the uppermost foot of rock. Moreover, reports by drillers indicate that wide openings in the rock, such as those which have been formed by solution in carbonate rocks in many regions, are relatively uncommon in most of this area. However, openings penetrated in several drill holes at Massena Intake (see, for example, logs of wells 457-455-9 and -16) and at Snell and Eisenhower Locks show that solution has occurred locally to depths as great as 50 feet below the top of the bedrock; in these places the openings probably were formed by the solution of gypsum.

In a few places joints in exposed dolomite have been widened to form small sinkholes at the land surface. It is probable that extensive solution openings were developed in the dolomite throughout the area in the past but that the upper part of the rock, containing most of these openings, was removed by glacial erosion.

In the walls of quarries observed by the writers horizontal or gently dipping fractures, more or less parallel to the bedding of the dolomite, are wider and more numerous than steeply-dipping fractures. Moreover, hydrologic data from wells show that the horizontal permeability of the dolomite is commonly much greater than the vertical permeability. Thus, it appears that the horizontal openings in the dolomite are generally larger and more abundant than the steeply-dipping ones.

Other types of openings have been observed in the dolomite in a few places but appear to be unimportant. The writers have seen zones of rock containing holes a fraction of an inch to an inch or more in diameter in a few places. In other places, however, similar cavities have been filled with calcite. And in all these places the rock between the holes is sound and tight, and the holes are not interconnected.

Configuration of the Surface of the Bedrock

Figure 4 shows the locations of bedrock outcrops in the Massena-Waddington area and of wells which reach bedrock, and generalized contours on the bedrock surface. This map, supplemented by a topographic map and by well data in table 11, will aid drillers, property owners, and others in estimating the approximate depth to bedrock at places where there are no weils.

The surface of the bedrock slopes generally northward. Its most prominent feature is a broad valley which trends northeast, passing beneath Madrid and Raymondville. A smaller valley underlies the peninsula which separates the St. Lawrence and Grass Rivers near Snell and Eisenhower Locks (Wilson, 1946b). The small streams in the area do not follow depressions in the bedrock surface. The St. Lawrence River crosses several high places on the bedrock surface; in places it may have followed a depression in the bedrock, but this possibility cannot be verified without data from Ontario. Numerous small hills on the bedrock surface are shown on the map. No doubt there are many more of these hills, and the true contour pattern must be much more complex than that inferred from the scattered data. The map suggests that there is no consistent relation between the configuration of the bedrock surface and that of the present land surface: some high places on the bedrock underlie hills but others have no surface expression. Reliable estimates of the depth to bedrock cannot, therefore, be made on the basis of land-surface topography alone.

Some idea of the complexity of the topography of the bedrock may be had from contour maps prepared by the Corps of Engineers (U. S. Army, 1942), by Wilson (1946b), and by Uhl, Hall & Rich (in the files of the Power Authority) in connection with subsurface investigations along the St. Lawrence River. (Selected contours from these maps are shown in figure 4).

At some places where the bedrock crops out in the bed of the St. Lawrence River It formed rapids. The chief of these were the Long Sault Rapids; others included rapids north of Ogden island, at Waddington (pi. 2A), and near Galop Island (fig. 3) farther upstream. All these rapids were submerged by flooding of the power reservoir.

Quaternary Deposits

The unconsolidated deposits which cover the bedrock in the Massena-Waddington area were laid down during and after the advance of Pleistocene ice sheets across the area. The deposits include till laid down by the glacial ice, clay and other materials deposited in standing bodies of water during and after melting back of the ice, deposits formed by the modification of the till and other sediments, and materials laid down after the large bodies of standing water had been drained. The sequence of deposits in the vicinity of the reservoir is summarized in table 3. The complete section is probably present at relatively few places, but the entire sequence, except for the peat and stream deposits, has been found at several places near the reservoir.

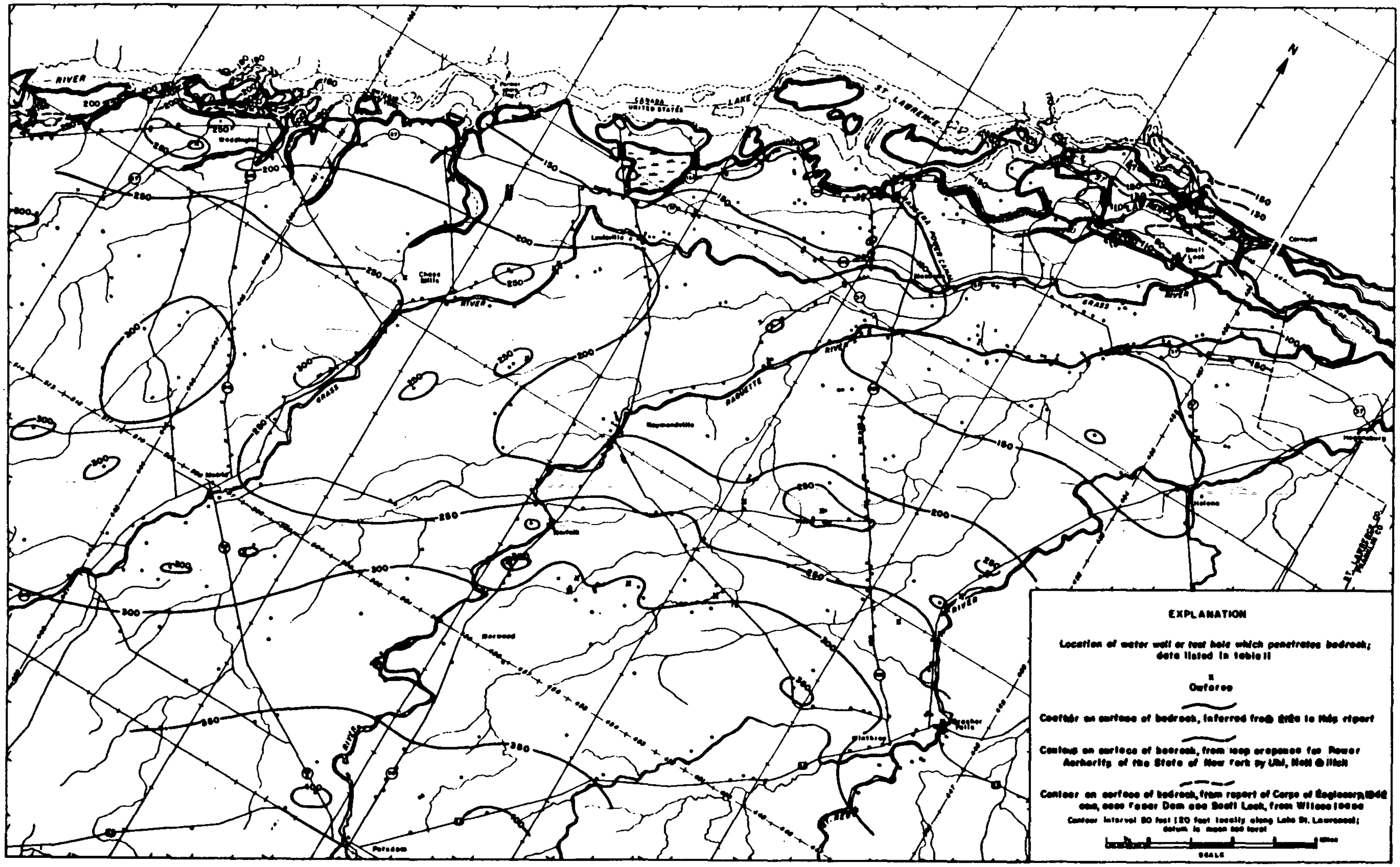


Figure 4.--Configuration of the bedrock surface in the Massena-Waddington area.

3.8

Table 3.--Unconsolidated deposits near Lake St. Lawrence, and Quaternary history of the Massena-Waddington area (after MacClintock, 1958, with additional data from files of Uhl, Hall, s Rich and from field observation). Youngest deposits and events are at the top

Deposits	Major events
Postglacial deposits	
Peat present locally throughout the area in poorly drained places	Deposition in marshes
Gravel, sand, silt, and clay in and beside stream channels throughout the area	Erosion and deposition by streams
Fort Covington drift	
Marine sand and gravel: a blanket of sand commonly 1-10 ft thick, on the underlying marine clay, and wave-washed deposits of gravel and sand on the tops and sides of many hills; contain marine shells; porosity of representative sand, 26-47 percent	Recession of Champlain Sea
Marine clay, sticky, in part sandy, and silt, blue-gray; contains marine shells and inclusions of plant material; locally contains sand layers; porosity of representative samples, 38-64 percent; commonly 30-60 ft thick; present in valleys throughout most of the area	Continued recession of ice front; eventual invasion of the basin, after it was freed of ice, by salt water, with formation of Champlain Sea
Clay (varved), with mixed (slumped) deposits of silt, sand, and gravel containing enclosed masses of till; found at many places in the vicinity of the power reservoir during subsurface investigations; may be widely present elsewhere in the area	Recession of ice front; formation of proglacial lake
Till (upper); unstratified mixed deposit of clay, silt, sand, and stones; moderately dense and compact (porosity of representative samples, 15-25 percent); brown to blue-gray; fabric with long axes of pebbles aligned NW-SE; locally rests on bedrock striated NW-SE; commonly 20-60 ft thick; underlies most of the area; locally mantled by outwash gravel and sand	Glacial advance from the northwest
Malone drift	
Clay (varved) and interbedded silt, sand, and gravel	Recession of ice front; formation of proglacial lake
Till (middle); mixed deposit of clay, silt, sand, and stones; unstratified, but in part interbedded with the underlying lake deposits; moderately to very dense and compact; brown to blue-gray; fabric with long axes of pebbles aligned NE-SW; including underlying and overlying bedded deposits have been found at many places in the vicinity of the power reservoir, particularly in hills; water-bearing sandy and silty deposits which appear to represent this till and the associated bedded deposits have been found in many hills throughout the area and probably are present in most hills	Renewed glacial advance from northeast
Clay (varved) and interbedded silt, sand, and gravel	Recession of ice front; formation of proglacial lake
Till (lower); unstratified mixed deposits of clay, silt, sand, and stones; very dense and compact (porosity of representative samples, 10-20 percent); blue-gray; fabric with long axes of pebbles aligned NE-SW; rests on bedrock striated NE-SW; commonly 10-40 ft thick; widely found in the subsurface in the vicinity of the power reservoir; probably present throughout the area	Glacial advance from the northeast

The conspicuous feature of the succession of deposits is the presence of two drift sheets composed of the Malone (older) and Fort Covington tills and associated deposits. MacClintock (1954, p. 5-6; 1958, p. 24) has correlated the Fort Covington glacial episode with the late Wisconsin (Valders) episode of the standard section in the midwestern United States, and the Malone glaciation with the earlier Wisconsin Cary advance of the Middle West. Both drift sheets are known in considerable detail near the reservoir, from surface excavations and subsurface exploration. They are known in much less detail in the rest of the Massena-Waddington area.

The sequence and character of the unconsolidated deposits near the reservoir are well illustrated by typical sections (figs. 5 and 6) which show unconsolidated deposits, 75 to 125 feet thick, overlying the bedrock. A basal till unit is overlain by two younger till deposits which are in part interrupted beneath the valleys. The till deposits are overlain, in turn, by stratified materials which characteristically include varved (fresh-water) clay beneath marine clay. Sandy layers are present in both the clay and the till, and in some places between the clay and the uppermost till.

The two main tills are the lower (basal Malone) and upper (Fort Covington) tills of MacClintock. They are composed of mixed clay, silt, and stones. Both are dense and compact, but the lower till is considerably more so than the upper till, a fact which contributed to difficulties encountered in excavation of the lower till in much of the construction work. Near the reservoir they were identified by Project personnel, using the gross characteristics of the materials, other characteristics (mechanical composition, density, etc.) shown by laboratory tests, and fabric (orientation of pebbles). The two tills are clearly separate deposits: their fabric and the striations on underlying rock surfaces show that they were laid down during different glacial advances; and the presence of brown (weathered) material in the upper part of the Malone drift indicates that it was exposed to weathering processes for some time before the advance of the Fort Covington ice. The two till layers were readily distinguished in the walls of several open excavations because of the presence of permeable materials, from which ground water seeped, at the bottom and top of the middle till (table 3, and MacClintock, 1958, frontispiece).

Although several hundred wells have been drilled completely through the unconsolidated deposits in the Massena-Waddington area outside the immediate vicinity of the reservoir, little information regarding the deposits has been preserved. Their character in the subsurface, outside the reservoir area, is therefore poorly known. A few logs show the thickness of clay in valleys. Interbedding of sand or gravel with till in several places (see logs of wells 447-513-1, 452-451-7, 455-459-8, 455-503-6, 456-454-10, and 456-455-33), and the presence of unconsolidated water-bearing materials in or beneath till (wells 441-505-4, 453-504-1, 454-459-12, 456-454-6, and -9, and 456-456-18, table 11), show that the older (Malone) drift sheet is present in much of the area.

Each till sheet contains interbedded layers of sandy or gravelly material a fraction of a foot to several feet thick. (See logs of the following wells in table 9: 451-457-2; 452-459-2; 453-507-14; 457-450-7; and 458-453-10.) Little is known about these layers but they appear to be

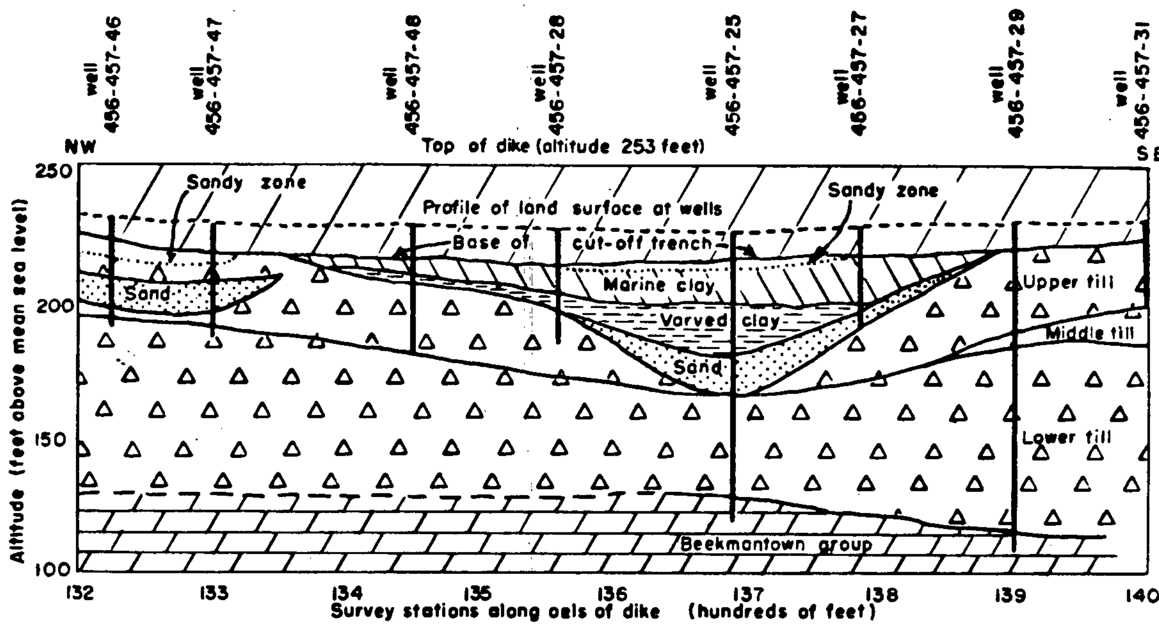


Figure 5.--Stratigraphic section beneath part of Richards Landing Dike. See plates 2A and 3 for locations of wells.

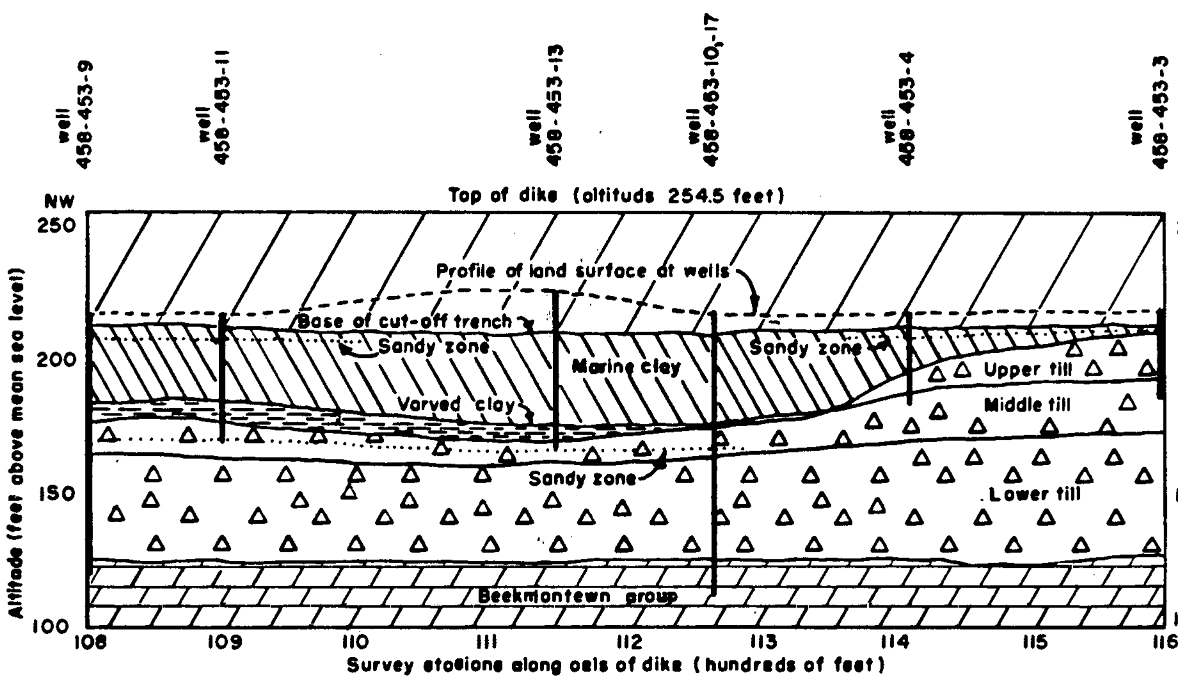


Figure 6.--Stratigraphic section beneath part of Long Sault Dike. See plates 2A and 3 for locations of wells.

thin tabular or elongate bodies of sorted material, of small extent, which are more or less completely enclosed in the till. They are thought to have been deposited on till by meltwater beneath the ice, and later to have been covered by till.

The middle till is considered by MacClintock to be part of the Malone drift because its fabric is like that of the lower till. The geologic interest and practical importance of the middle-till deposits are related to the presence of water-sorted materials interbedded with the till. These sorted materials are known to have been deposited in lake or pond water because they consist in part of varved clays and silts. MacClintock (1958, p. 12) believes they were deposited during a sequence of recession, re-advance, and recession of Malone ice in the water of a proglacial lake.

The till in the middle-till deposits has not been recognized during the drilling of water wells, probably because it does not differ markedly from the lower till except in being weathered in some places. However, beds of sorted material have been found batween till deposits in many wells. Where these beds are more than a few feet thick, and where they are known to be rather extensive, they are thought to represent the middle-till deposits rather than local layers of sorted material. Good examples of sandy or gravelly beds thought to represent the middle till are shown by the logs of the following wells in table 9: 451-451-3, 452-451-7, 455-503-6, 456-454-10, and 456-455-33. Other wells for which logs are not given (441-505-3 and -4; 454-501-17 and -19; and 456-502-2) furnish additional examples.

Figure 7 is an idealized section which illustrates the probable range of stratigraphic relationships among the unconsolidated deposits. It is likely that each of the layers of till is discontinuous, and that any one of them rests on the bedrock in some localities. The valleys between the till hills are partly filled with clay except where stream erosion has removed it. This clay is underlain by sand layers, or contains interbedded sand, and in some valleys it is also overlain by sand. The middle-till deposits, which are thought to be present chiefly beneath the hills (see the following paragraphs), crop out on some hillsides above the valley floors or terminate against clay or sand layers in the valleys. The till hills are locally mantled by outwash deposits and wave-washed material. Outwash and marine (Champlain Sea) sands have been blown into dunes, both on the hilltops and on valley floors.

It is noteworthy that all the wells cited earlier as penetrating the middle till are on hills. At some places near the reservoir (see, fpr example figure 6) the middle-till deposits extend laterally beneath the adjacent valleys; at other places (fig. 5) they do not. In several wells on hills (456-456-18, 454-501-19, and 451-451-3) the bedded deposits are above or about at the levels of the adjacent valley floors, and therefore probably do not extend beneath the valleys. The relatively few data available strongly suggest that the middle-till deposits beneath the hills commonly do not extend beneath the valleys. On the basis of detailed and extensive subsurface studies in the vicinity of the power reservoir Mr. John N. Harris, of Uhl, Hall & Rich, concluded (oral communication, 1958) that the middle till characteristically occurs in the hills near the reservoir and that it probably is present in most of the elongate hills elsewhere in the Massena-Waddington area. The writers believe that the subsurface data

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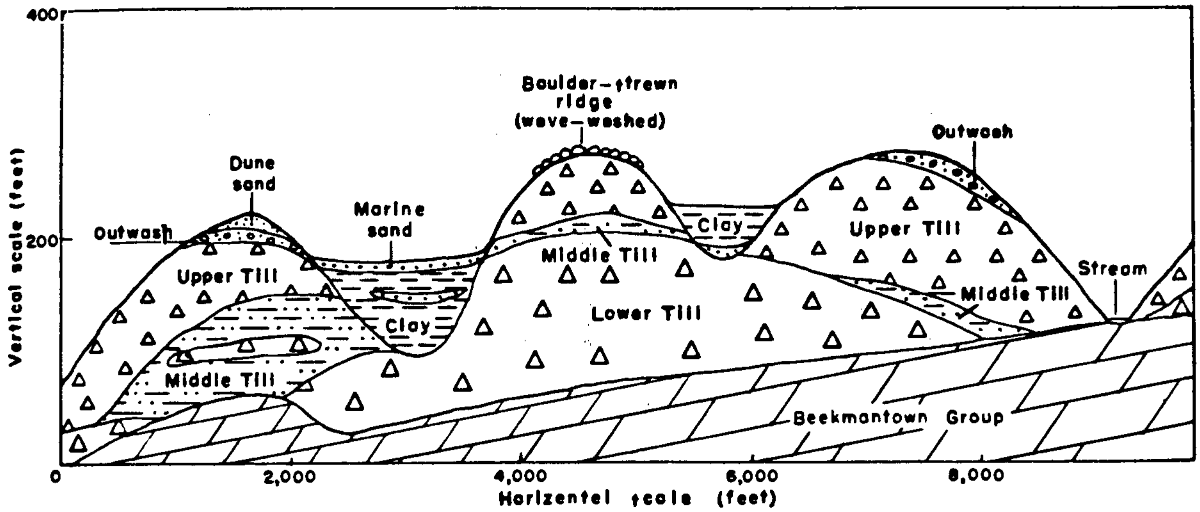

Figure 7.--Idealized stratigraphic section showing sequence of unconsolidated deposits in the Massena-Waddington area.

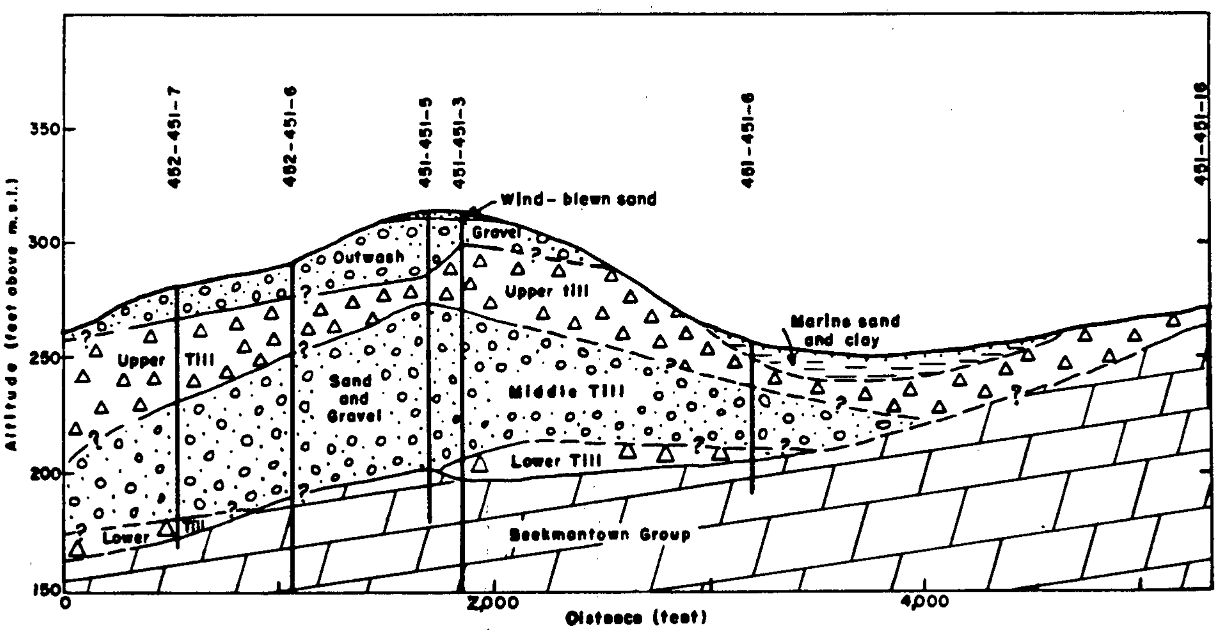

Figure 8.--Stratigraphic section along NY Highway 420 in the vicinity of well 451-451-3.

3.14

available outside the reservoir area, already cited, and the surface form of the hills substantiate this conclusion.

The evidence from the form of the hills is as follows. The land surface in the Massena-Waddington area is marked by two dominant types of physiographic features: (1) elongated hills whose long axes commonly trend northeast-southwest, giving the topography a conspicuous grain; and (2) broad valleys with flat or gently sloping floors which lie between the hills. These features are chiefly of depositional origin and are composed of glacial drift. Till is a chief or important component of all the hills, and it underlies the valleys beneath any clay or sand which may be present. MacClintock (1954, p. 9) considers that many of the elongated hills are drumlins or are surmounted by drumlins, but recognizes an apparent inconsistency between this interpretation and the orientation of the hills relative to the direction of the last glacial advance. Drumlins are hills, commonly oval or elongated in plan and composed of till, which are present in many glaciated regions. They are widely considered to be largely of depositional origin and to have been deposited with their long axes parallel to the direction of ice movement during the last part of a glacial episode. in the Massena-Waddington area the elongated hills trend southwest, even though the last (Fort Covington) ice sheet moved southeast. The writers believe that, while some of these hills are true drumlins and some are not, probably most or all of them owe their form to deposition during the Malone glaciation. in some hills which contain deposits of middle-till type the top of the lower till is level with or above the adjacent valleys; hills of Malone till were present at these places and were not removed by the later Fort Covington ice. Most of the examples of the middle-till deposits cited above are probably in hills of this type. in other hills the Malone deposits are chiefly sand and gravel which also were not completely eroded by the Fort Covington ice.

Figure 8, a section through a hill about 4 miles south of Massena, shows that a hill of sand and gravel was present at this site before the Fort Covington glaciation. This hill in turn rests on a high part of the underlying surface of till and bedrock. Much of this sand and gravel (the lower deposit of sand and gravel in well 451-451-3, fig. 8) is fine grained and silty, and a 9-foot layer of sandy and gravelly clay is interbedded with the coarser materials; these sediments suggest deposition in standing water. MacClintock (1958, p. 12) considers that the front of the Malone ice retreated by calving in lake water, basing his conclusion on the presence of varved sediments interbedded with the middle till. The occurrence of a layer of probable lake sediments in well 451-451-3 suggests that the material was deposited in a delta at the front of the ice. The writers believe that cracks in the ice were more common above buried hills than above flatter terrain because of stresses in the ice during its movement across the irregular floor; that melting proceeded most rapidly in these fractured zones; and that streams on the ice or in tunnels or crevasses in it were better developed in the more fractured ice than elsewhere. Such development of streams probably would have led to the formation of embayments in the ice front above many of the hills, and would thus have facilitated the deposition of outwash sediments on the hills. During the Fort Covington glaciation these bedded deposits were in part eroded and then were covered by till. The younger sand and gravel was similarly deposited in standing water during melting of the Fort Covington ice. According to this hypothesis, the bedded deposits are likely to be (but are not necessarily) present in any of the hills, but probably are not present beneath the valleys.

Recession of the Fort Covington ice was also accompanied by the development of a proglacial lake. Unlike the lake of Malone time, however, the lake in front of the Fort Covington ice was succeeded by a body of marine water, the Champlain Sea. The sections in figures 5 and 6 therefore show varved clay, which rests on the uppermost till in the valleys, overlain by marine clay. In many places the marine clay is in turn overlain by sand deposited during the shoaling phase of the Champlain Sea. This sand mantles the clay locally along the valleys crossed by Richards Landing and Long Sault dikes but is not shown in figures 5 and 6. During the period of submergence by the Champlain Sea many hills were mantled with a layer of fossiliferous bouldery gravel. This material, considered to have been formed from till on the hilltops by waves, is termed winnowed till by MacClintock (1958, p. 14).

Plate 1 shows the distribution at the land surface of the stratified deposits of the Champlain Sea (clay and sand), and of the till of the younger (Fort Covington) glacial episode. The deposits of the Malone glaciation are not exposed.

The range in thickness of the individual deposits of unconsolidated material is shown in table 3. The thickness of unconsolidated material penetrated by 606 wells in the Massena-Waddington area ranges from 0 to 166 feet (well 454-502-8); in 85 percent of the wells the thickness is 100 feet or less, and in 50 percent of the wells it is 26 to 75 feet. The average thickness is about 60 feet.

3.16

Occurrence

Unconsolidated Deposits

The areal distribution of unconsolidated deposits at the land surface in the Massena-Waddington area (pl. 1) is characterized by the presence of till beneath the hills and of stratified deposits, chiefly clay covered by a thin layer of sand, beneath the valley floors. The till undoubtedly

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extends beneath the stratified deposits in the valleys. Stratified deposits also cover the till on some hills. Taken as a whole, both the till and clay are relatively impermeable. However, both contain interstratified layers of sandy and silty material which are relatively permeable. The wide range in permeability of the materials, and the interstratification of beds in many places, are important in determining the water-bearing characteristics of the unconsolidated deposits.

Unconfined ground water

The surficial deposits (and locally the bedrock where it is at or near the land surface) in the Massena-Waddington area constitute several unconfined aquifers, each of which lies between and is drained by two of the major surface streams. Within each interstream tract the deposits form one more or less continuous aquifer with one main water table; the aquifer and the water table may be discontinuous locally where impermeable material such as tight clay is present. In each aquifer the unconfined ground water moves from the hilltops into the flanking valleys, and thence toward the larger valleys, and eventually is discharged into one of the master streams. Each aquifer is a dynamic system from which water is continually being discharged (at an ever-changing rate), and to which water is being added intermittently. With continual adjustment of head, and hence of rate of flow, a state of approximate balance is maintained, under natural conditions, between rates of discharge and recharge.

Plate 2B shows the configuration of the water table in April 1957 in the tract between the St. Lawrence and Grass Rivers. The relief on the water table reflects the surface topography; that is, the water table stands higher beneath the hills than beneath the valleys.

Flow of the unconfined ground water is in the direction of the slope of the water table (perpendicular to the contours shown in pl. 2B). Much of the discharge of the ground water is through seeps which feed streams and marshes on the valley floors at places where the water table stands at the level of the valley floors; the discharge occurs because the clay, which generally underlies the surficial sand in the valleys, is too impermeable to permit much water to flow through it, and because where the sand is thin it may be completely saturated without providing sufficient gradient to transmit the ground water down the valley. The unconfined ground water is also discharged in other ways. In places on the slopes and valley floors where the water table is near the surface, ground water is returned to the atmosphere by evaporation from the soil and by transpiration of plants. Finally, water levels and chemical-quality data for artesian aquifers in the unconsolidated deposits and in the bedrock show that in some places the unconfined aquifers also discharge water by leakage into the deeper aquifers at places where the water table stands higher than their piezometric surfaces.

Recharge of the water-table aquifers is chiefly by the infiltration of water which falls on the land surface. Some recharge probably occurs also by upward leakage from artesian aquifers at places where the piezometric surface stands higher than the water table, as in some valleys. As is noted in the section describing fluctuations of ground-water levels, recharge to the water-table aquifer occurs chiefly in the autumn and in the spring.

The permeability of water-bearing material in the unconfined aquifer between the St. Lawrence and Grass Rivers was determined at three localities. Wells 454-502-1 (in till) and 453-507-6 (in sand) were tested by pumping; surficial sand at Waddington was tested by a laboratory method. Both deposits of sand that were tested are deposits laid down in the Champlain Sea during its late stage, but the sand tapped by the well is finer than that at Waddington.

Well 454-502-1 was pumped dry in 35 minutes, and the subsequent recovery of the water level was measured. Because the duration of pumping was very short relative to that of recovery (which required 6 days) the test data were treated as if a single large bucketful of water had been removed from the well, and were analyzed by a "bailer" method devised by Skibitzke (Ferris and Knowles, 1955, p. 33-34). The value obtained for the coefficient of transmissibility 1/ of the till is about 20 gallons per day per foot. Because the water level in the well was lowered about 14 feet by the pumping, the coefficient of permeability of the till at the prevailing ground-water temperature (45°F) is about 20/14 or about 1.4 gpd per square foot. Adjusted to a temperature of 60°F (Wenzel, 1942, p. 62) for comparison with the laboratory value cited in a later paragraph, the permeability is 1.8 gpd per square foot. (it is possible that these values for the transmissibility and permeability are too high because it was assumed that no water flowed into the well from below, a condition which probably was not fulfilled.)

Well 453-507-6 was pumped dry in 6 minutes. The water level returned approximately to its former static position in 1½ days. The data were analyzed as in the test of well 454-502-1. The coefficient of transmissibility of the sand is about 32 gpd per foot, and the coefficient of permeability at field temperature is 32/5 or about 6.4 gpd per square foot. (Adjusted to 60°F the permeability is 7.5 gpd per square foot.) The assumption that no water flowed into the well from beneath appears to be valid because the well taps nearly the entire thickness of sand. The sand is underlain by clay.

The values of permeability noted above are approximate average values for the till and the sand tested because these materials are not homogeneous at these localities.

The permeability of the sand sampled at Waddington, tested by a method described by Wenzel (1942, p. 64), is about 300 gpd per square foot. This sand is coarser than that penetrated by well 453-507-6 and does not contain much silt and clay. The result of the test is not strictly comparable with those of the two pumping tests. In the laboratory the permeability was measured vertically (perpendicular to the bedding), while in the other tests the permeability determined reflects chiefly the effects of horizontal flow. Moreover, the very small sample (a few hundred grams) tested in the laboratory may be less representative of the aquifer than the much larger samples tested by pumping. However, the range in permeability suggested by

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1/ The coefficient of transmissibility, a measure of the rate at which an aquifer transmits water, is expressed in terms of gallons per day through a strip of the aquifer 1 foot wide, perpendicular to the direction of flow of the water, extending the full height of the aquifer, at a gradient of 1 foot per foot. It is equal to the permeability multiplied by the thickness of the aquifer.

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the three values obtained appears reasonable as an approximation for the unconsolidated materials in this area. Part of the till and most of the clay are probably less permeable than the till tested, and well-sorted sand and gravel present locally may be somewhat more permeable than the sand sampled at Waddington. The low permeability of the sand tested by pumping, 7.5 gpd per square foot, is attributed to the fact that it is fine and contains considerable silt and clay. The much more permeable sand at Waddington, on the other hand, is medium grained and well sorted.

The physical significance of such values for permeability may be illustrated as follows: if the gradient of the water table in the till is taken as 1 foot in 50 feet (a figure representative of conditions in many hills in this area) the quantity of ground water which moves through 1 square foot of saturated till (section taken perpendicular to direction of flow) is 1/50th of 1.8 or about 0.03 gpd; a water-table gradient of 1 foot in 200 feet in sand like that sampled at Waddington would cause 1/200th of 300, or 1.5 gpd, to move through each square foot of aquifer. Pumping from a well increased the water-table gradient near it and hence increases the rate of flow of the water. Nonetheless, even materials several times more permeable than those tested by pumping would yield only small quantities of water to wells. This explains why numerous wells which once yielded adequate domestic water supplies from till were inadequate after pressure water systems and indoor plumbing came into use, and why many other wells in till yielded supplies sufficient for single families even after the advent of pressure systems but proved inadequate when the use of water increased under the more crowded conditions of the construction period.

The distribution of the unconsolidated deposits (pl. 1), considered in conjunction with local conditions of topography and drainage as observed in the field, indicates that in the more thickly-settled parts of the Massena-Waddington area and in the remaining parts most suitable for settlement the relatively impermeable till is more widespread than the relatively permeable deposits of sand or gravel. Moreover, in many places where sand is at the surface it is only a few feet thick and is underlain by relatively impermeable till or clay. The quantity of water which can be obtained from the unconfined aquifer in the unconsolidated deposits is therefore small in most parts of the area.

Despite the relatively low permeability of the surficial deposits which constitute the unconfined aquifers, these aquifers have been economically important in the past because they have provided domestic and farm water supplies to large numbers of dug wells. A few dug wells, particularly those in the more permeable and thick deposits of sand (for example, wells 452-506-1 and 455-458-16) produce moderately large farm supplies. Few new wells are now constructed in the unconfined aquifers, chiefly because the quantities of water available in many places are limited and because many of the dug wells go dry during many or most years.

Confined ground water

Layers of sand and gravelly sand in clay or till, or interbedded with these deposits or lying between them and the bedrock, form confined aquifers in the unconsolidated deposits in the Massena-Waddington area. These aquifers are best known in the vicinity of the power reservoir because of the extensive excavations and subsurface explorations there, but enough of them have been found elsewhere to show that they are probably present in the glacial drift throughout the area.

Aquifers in clay.--The clay in the Massena-Waddington area is relatively impermeable and does not yield water to wells. Locally, however, it contains layers of permeable sand which transmit water in usable quantities. Such layers are known to occur in clay near the reservoir; they have not been reported elsewhere in the area, but in a number of places layers of sand have been found between clay and the underlying till.

Sand layers in clay were found in many test holes along the Richards Landing Dike (pl. 2A). One layer, shown in figure 5 in the center of the valley just beneath the cutoff trench under the dike, is at least 590 feet long (along the valley) and more than 200 feet wide (across the valley). Its thickness ranges from a few inches to 2½ feet, and its upper surface is 10 to 15 feet below the land surface at the toe of the dike. The sand is fine to coarse, silty and pebbly, and contains marine shells. This layer, which is tapped by numerous observation wells (for example, 456-457-13, tables 9 and 11) and pressure-relief wells (for example, 456-457-55), contains water under artesian conditions. The aquifer was tested in 1957 by pumping from a well finished in it and observing water-level changes in several observation wells; the rate of discharge was 2 gpm for a period of 4 days. The coefficient of transmissibility determined by this test is about 500 gpd per foot; the coefficient of storage 1/ is about 0.0005. The gradient of the piezometric surface, measured in a section along the valley, was about 1 foot in 600 feet just before the test; the total flow through the aquifer under natural conditions (the product of gradient, coefficient of transmissibility, and width of aquifer) was therefore about 1/600 x 500 gpd per ft x 200 ft = 167 gpd. The coefficient of permeability of the aquifer, in gallons per day through a square foot of the material (perpendicular to the direction of flow) is about 500/2 or about 250 gpd per square foot. This aquifer was not entirely cut off during construction of the dike and the pumping test showed that pressure changes are readily transmitted beneath the dike. The source of the water in the aquifer is thought, on the basis of the test data and of non-pumping water levels, to have been a pond a short distance north of the dike. (The possibility that the increased pressure which would be transmitted through the aquifer after flooding of the reservoir might endanger the dike was recognized by Project personnel, and pressure-relief wells were constructed by the Power Authority along the south side of the dike.) Although the reservoir level has been 5 to 6 feet higher than the former level of the pond (in which the water-surface altitude was about 234.5 feet in July 1957), the pressure in the aquifer downstream from the dike has been only slightly greater than it was before flooding of the reservoir because the relief wells readily discharge the additional water now being transmitted through the aquifer.

1/ The coefficient of storage is the volume of water the aquifer releases from or takes into storage per unit surface area of the aquifer per unit change in the component of head normal to that surface. For example, the storage coefficient determined for the sand aquifer at Richards Landing Dike indicates that 0.0005 cubic foot of water (about 0.004 gal.) is released from each section of the aquifer one foot square when the pressure declines one foot.

Other test and observation wells near the reservoir have penetrated sand layers between clay and till (for example, wells 456-453-1, 456-457-25, 458-451-2, and 458-453-11, tables 9 and 11) or between clay and the underlying bedrock (457-454-6). A number of shallow observation wells were constructed in clay by the Aluminum Company of America (457-453-10, -11, and -12). Probably no wells obtain water supplies from the clay where it does not contain sand layers.

A former domestic-supply well, 457-454-1, is thought to tap a sand layer in or beneath clay; the well is at the edge of a valley underlain by clay, and clay was found in a shallow excavation near the well. A 3-foot rise of water level in the well (see hydrograph, fig. 22) after flooding of the reservoir, which is about 1,000 feet away, shows that the well taps a relatively permeable aquifer of considerable lateral extent. The aquifer was tested by pouring a measured quantity of water into the well, observing the subsequent decline of the water level, and analyzing the data by a method described by Ferris and Knowles (1954). The value obtained for the coefficient of transmissibility of the aquifer, about 400 gpd per foot, is consistent with the interpretation that the well taps a relatively thin sand layer. Although this aquifer is probably in or just beneath the clay it is believed to be connected laterally with an aquifer (possibly the middle till) in the hill that lies between the clay-filled valley and the reservoir; such a connection would explain the rise of water level in the well after the reservoir was flooded.

<u>Aquifers in till</u>.--The till in the Massena-Waddington area is relatively impermeable but it is considerably more permeable than the clay. Nonetheless it probably transmits water in usable quantities at relatively few places except where it contains layers of sand or where it has been slightly sorted. Layers of sand are thought to be of widespread occurrence in the till; and, as has been noted in the chapter on geology, the layers of sand and gravel associated with the middle till are thought to be present in many or most of the till hills throughout the Massena-Waddington area.

The logs of numerous wells record layers of sandy or gravelly material, a fraction of a foot to several feet thick, in the till; some of the logs note that the sand layers rather than the enclosing till are water-bearing in the practical sense. (Good examples of logs in table 9 are 451-457-2, 452-459-2, 453-507-14, 457-450-7, and 458-453-10.) The presence of these layers in the till in so many of the wells for which adequate logs were preserved strongly suggests that the effectiveness of a well in till is largely dependent on its penetrating one or more of these layers. Artesian conditions are likely to be developed in some degree at many places in the till. Where the till is composed of slightly sorted material, however, as is true near the land surface in many places, the water is unconfined.

In addition to the thin sand layers which appear to be characteristic of the till in most places, thicker layers of sand or of interbedded sand, silt, and till which probably represent the middle till have been found in several wells. In test holes along the dikes the middle till was identified by Project personnel on the basis of laboratory tests of the materials. In other wells the thickness of these water-bearing layers, their occurrence between till sheets, or in some places their considerable lateral extent suggest that the layers are middle-till deposits rather than sand layers, which are likely to be thin, local, and discontinuous.

Good examples of these middle-till deposits are shown by the logs of wells 451-451-3, 452-451-7, 455-503-6, 456-454-10, and 456-455-33. Wells 451-451-3 and 452-451-7 penetrated deposits similar in character, sequence, and thickness; the two wells are about 1,300 feet apart. Well 454-501-17, which taps pebbly sand beneath till, has for several years provided a water supply adequate for a house and 11 tourist cabins; well 454-501-19, about 150 feet northeast, passed through a 10-foot layer of pebbly sand (reportedly more "runny" than the sand tapped by well -17) which is overlain and underlain by till. At these localities the water-bearing layers extend laterally for considerable distances. Similar layers of sorted material have been found in a few other wells (for example, 456-502-2, and 441-505-3, and -4). Water seeps out at numerous places along the west base of the hill in which wells 441-505-3 and -4 were drilled; the seeps appear to be at about the same altitude as the sand layer in the wells, and it is possible that they are fed by this aquifer.

Several wells in till for which logs are not available probably tap the middle till or similar aquifers. One of these (456-455-20, fig. 22) is a 37-foot dug well about nine-tenths of a mile south of Massena Intake and across the valley of Dodge Creek from it. The water level in this well responded to flooding of the power reservoir; the well is therefore connected hydraulically with the reservoir. Another well (456-456-18), on the till hill about nine-tenths of a mile west of Massena intake, was finished in the unconsolidated deposits; because the bottom of the casing is at about the altitude where the middle till was found at Massena Intake, the well is thought to tap that aquifer.

As is noted in the chapter on water-level fluctuations, the recharge of the aquifers in the till is by downward movement from the overlying unconfined aquifer except at some places along the edge of the reservoir. Discharge probably occurs both by the lateral flow of water to seeps in the adjacent valleys and by the flow of water downward to the bedrock.

The probable wide occurrence of confined aquifers in the till, and their successful use for domestic and farm water supply in a few localities, suggest that these aquifers might be more widely utilized. That they have not been widely used is due partly to failure of some of the wells because of clogging by slit or sand, with resultant distrust of such wells by drillers and property owners, and partly to the difficulty experienced by drillers in developing successful wells in these deposits with open-end casing. in some places these aquifers could be used, and would undoubtedly yield water of better quality than that in the underlying bedrock. Construction of successful wells would commonly require well screens and development by surging and pumping, however, and it appears that the cost of these practices might exceed the saving offered by the lesser depths of the wells. The places most favorable for attempts to develop any aquifers found in the till therefore appear to be where water in the bedrock is known to be of poor quality or where nearby wells in the rock are known to be very deep and, thus, somewhat expensive.

Consolidated Rocks

Water in the consolidated rocks in the Massena-Waddington area occurs nearly everywhere under confined or artesian conditions. In a few places, however, where the bedrock forms hills and is exposed or has a thin soil cover, the ground water is unconfined.

Confined ground water

The upper part of the bedrock constitutes a more or less continuous aquifer which is believed to underlie the entire Massena-Waddington area. Water-bearing zones in the deeper parts of the bedrock are thought, on the basis of water levels and chemical-quelity data, to be rather effectively separated from the upper part of the rock. All these aquifers, except locally the one in the upper part of the rock, are confined or artesian.

Upper water-bearing zones.--Figure 9 shows the generalized configuration of the piezometric surface for, and hence the distribution of artesian pressure in, the upper part of the bedrock during June 1958, just prior to the flooding of Lake St. Lawrence. In drawing figure 9 water-level measurements made in June 1958 were supplemented with measurements made before or after June 1958. A correction factor was applied to the supplementary measurements to make them consistent with the measurements made in June 1958. The correction factors are listed in table 4. Except for the

Table 4.--Factors used, for wells which tap bedrock, to adjust water levels to their approximate values for June

Month	Factor (feet)	Month	Factor (feet)
January	-1	July	+2
February	-1	August	+3
March	-2	September	+4
April	-3	October	+3
May	-1	November	+1
June	0	December	0

tract north of the Grass River, in which water levels rose as a result of the flooding, the map is representative of conditions after June 1958, Seasonal and longer-term fluctuations in pressure, which are characteristic of nearly all the aquifers, change the altitude of the piezometric surface somewhat at any given locality but its configuration undoubtedly is little changed. The following fundamental conclusions about the aquifer in the upper part of the bedrock are drawn from this map: (1) recharge of the aquifer in most of the area occurs in the interstream tracts (where the piezometric surface rises in broad mounds); (2) the aquifer is drained by those surface streams along which the piezometric surface is indented upstream; and (3) in a qualitative sense the steep gradients on the piezometric surface near the rivers show that the upper part of the bedrock has relatively low vertical permeability. These conclusions are discussed in the following paragraphs. (Conditions in the part of the area north of the Grass River after July 1, 1958, are described in the chapter on water-level fluctuations.)

Comparison of the piezometrie-surface map with the map of the water table north of the Grass River (pi. 2B) and with water levels for water-table wells south of the Grass River (table 11) shows that the water table is nearly everywhere higher than the piezometric surface. This fact, with the similarity in hydrologic regimen shown by many of the hydrographs for both artesian and water-table wells (for example, wells 452-452-1, -7, -9. and -10 in fig. 15, which tap aquifers in and beneath a single hill),

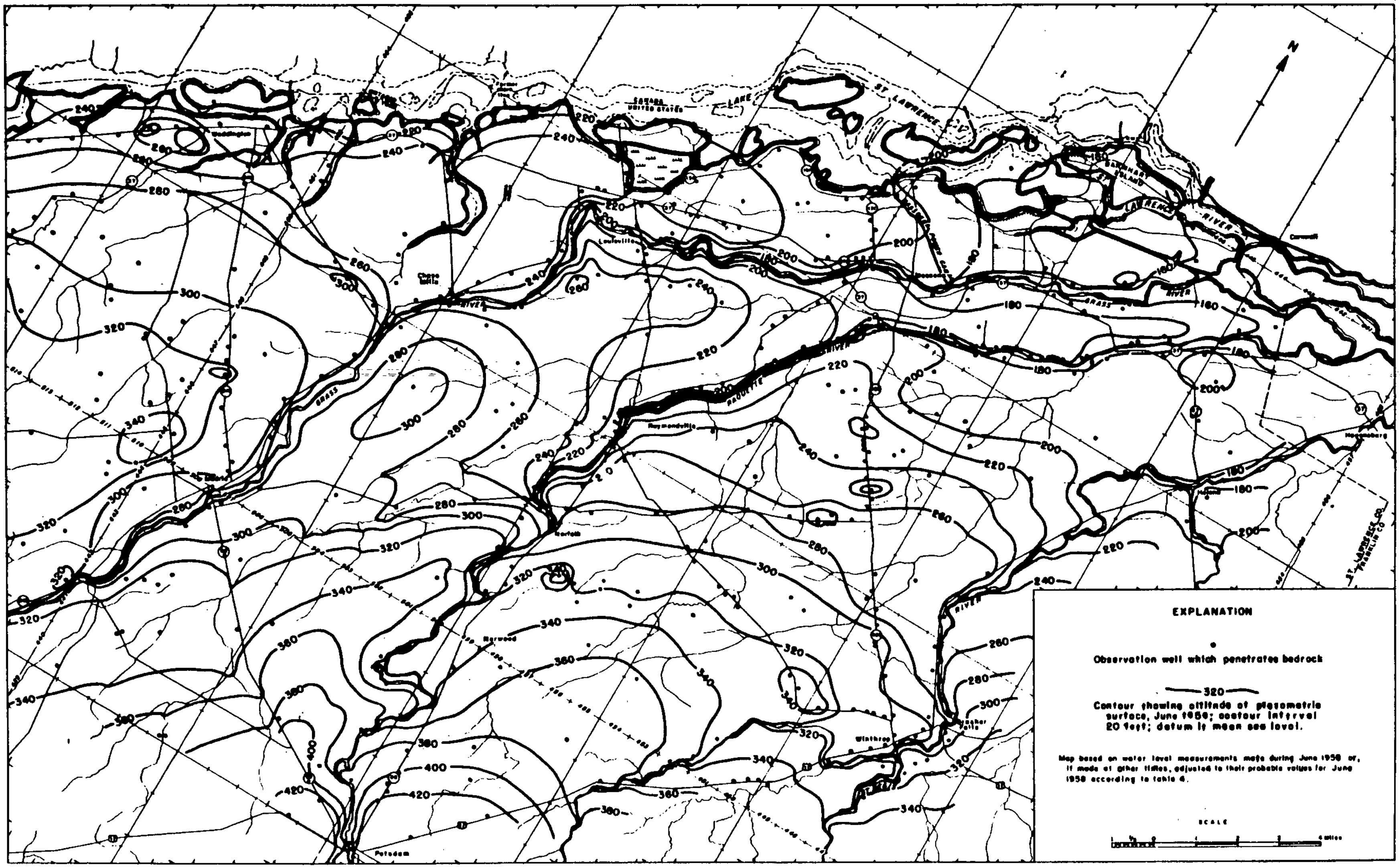

Figure 9.--Map showing configuration of the piezometric surface for the upper part of the bedrock in the Massena-Waddington area, June 1958.

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shows that the aquifer in the upper part of the bedrock receives water by downward flow from the overlying unconfined aquifers. Bedrock is exposed at so few places that its effect in receiving recharge directly from precipitation must be negligible. The form of the piezometric surface shows that recharge of the aquifer in the upper part of the bedrock occurs generally in the tracts between the major surface streams. The presence of mounds on the piezometric surface beneath many hills (as, for example, near wells 447-450-1, 450-514-2, 451-451-5, and 452-452-9, in fig. 9) shows that recharge is evidently more effective beneath hills than elsewhere nearby. (A mound on the piezometric surface indicates recharge because ground-water movement is outward, away from the mound, in the direction of decreasing pressure. Conversely, a depression in the piezometric surface indicates discharge because movement in that region of the aquifer is toward the depression.) At some of these places the increased effectiveness of recharge is probably due to the fact that the water table beneath the hill stands much higher than beneath the adjacent lower terrain, with a consequent greater head difference between aquifers. If sufficient data were available, the piezometric surface would undoubtedly show many more mounds like those in figure 9; it might also show irregularities between large adjacent tracts underlain by till and by clay, respectively, reflecting the somewhat greater permeability of the till.

The aquifer in the upper part of the bedrock is drained by the major surface streams. This drainage, through seeps and springs in the river beds, accounts for much of the discharge of the aquifer. Part of the discharge is downward toward deeper zones in the rock, and the deeper aquifers are probably recharged chiefly in this way. Pumping also provides part of the discharge, and in a few localities appears to drain the upper part of the rock more rapidly than it is recharged by lateral flow through the aquifer, with the result that some water rises into the local region of reduced head from deeper in the rock.

Tablo 11.--Records of selected wells in the Massnna-waddington area, St. Lawrencc County

Well number: Seo explonation in section entitled "Well-numbering system."

Location: See plates 1 and 2.

Owner: ALCOA, Aluminum Company of America; PASNY, Power Authority, State of New York.

Driller: See list of drillers in Table 8.

Type of well: Aug, augered; Orl, drilled (cable-tool); Orl (R), drilled (rotary); Dug Orl, drilled in dug well; Dv, driven.

Depth of well: Depth stated to nearest foot; r, reported depth (all other depths measured).

Depth of casing: Depth stated to nearest foot; in drilled wells: depth of bottom of steel casing; depth of top of slots or screen, where present; or depth of porous piezometer element, where present; in dug wells: depth of bottom of any casing (such as tile or culvert pipe) which prevents infiltration of water except through bottom; depth omitted for stone-curbed dug wells.

Diameter: Diameters of dug wells are approximate; where two or more sizes of casing are present in a drilled well the top and bottom diameters are given; where a drilled well is in a dug well the depth and diameter of the dug well is given.

Depth to bedrock: Depth stated to nearest foot.

Water-bearing material: Unconsolidated deposits of Pleistocene age: S, sand; G, gravel; C, clay; T, till; U, undifferentiated; consolidated rocks: Crystalline, igneous or metamorphic crystalline rocks; Ss, sandstone (Cambrian and Ordovician); Dol, dolomite of Beekmantown group of Ordovician age; Ls, limestone of Chazy dolomite (Ordovician); R, undifferentiated.

Measuring point: Altitudes given to the nearest tenth or hundredth of a foot were measured with surveying instruments; altitudes given to the nearest foot were measured with a barometric altimeter (b) or hand level (h) or estimated from topographic maps (a). Measuring points for wells along dikes described as of June 1958.

Water level: H, additional water-level measurements shown graphically in this report; F, additional water-level measurements on file in Albany office of the U.S. Geological Survey, Branch of Ground Water; r, reported water-level measurement (all other water levels measured); +, water level in feet above measuring point.

Method of lift: Pump: B, bucket; Cen, centrifugal ("shallow-well" pump); Cyl, cylinder; Jt, jet; P, pitcher pump or other suction-type hand pump; Sub, submersible; Turb, turbine; power: E, electric motor; H, hand; Jh, pump jack with electric or gasoline motor; W, windmill.

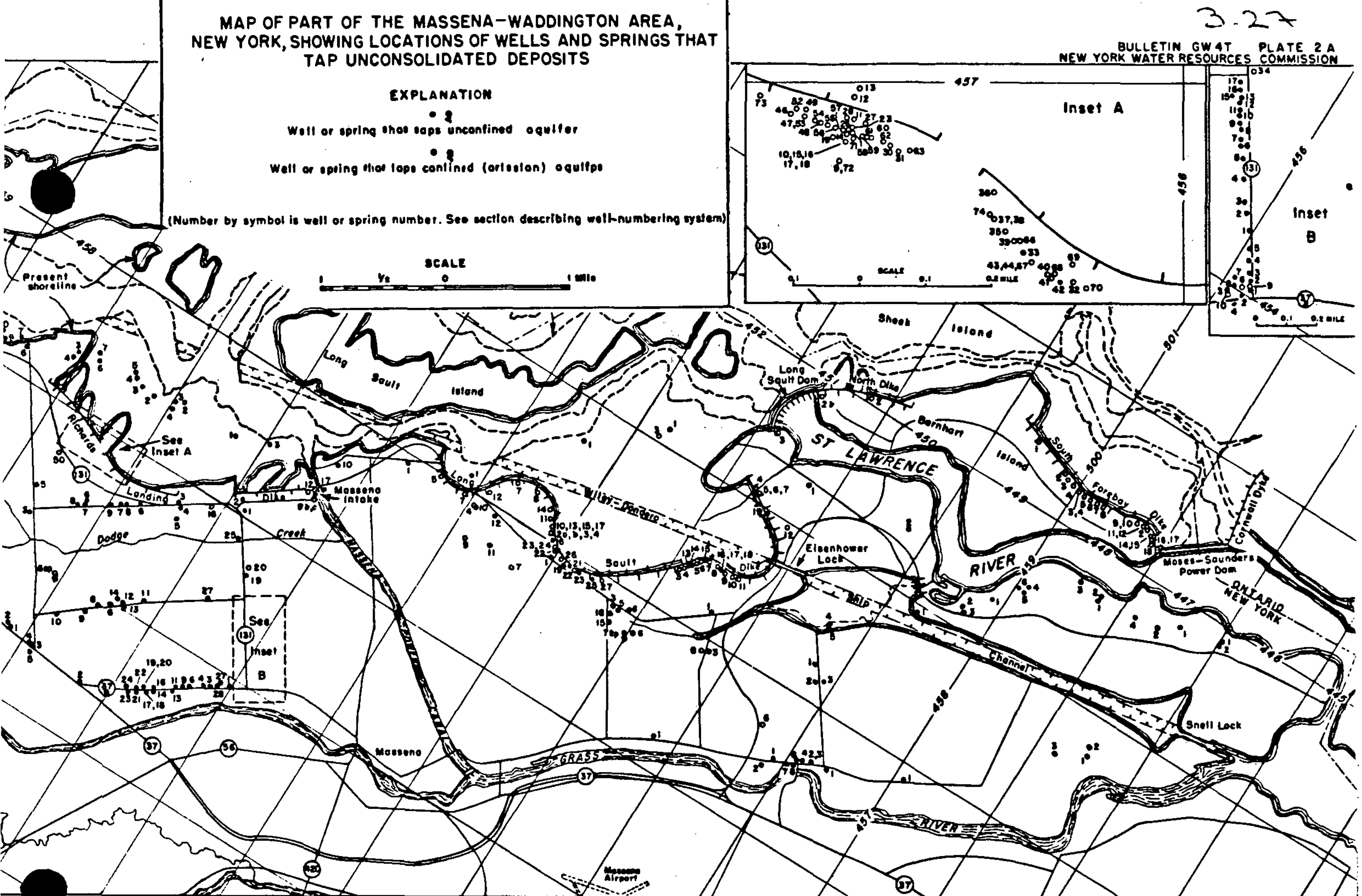
Chloride concentration: ppm, parts per million; L, analysis in laboratory of U.S. Geological Survey, Branch of Quality of Water (all other values obtained by field analysis).

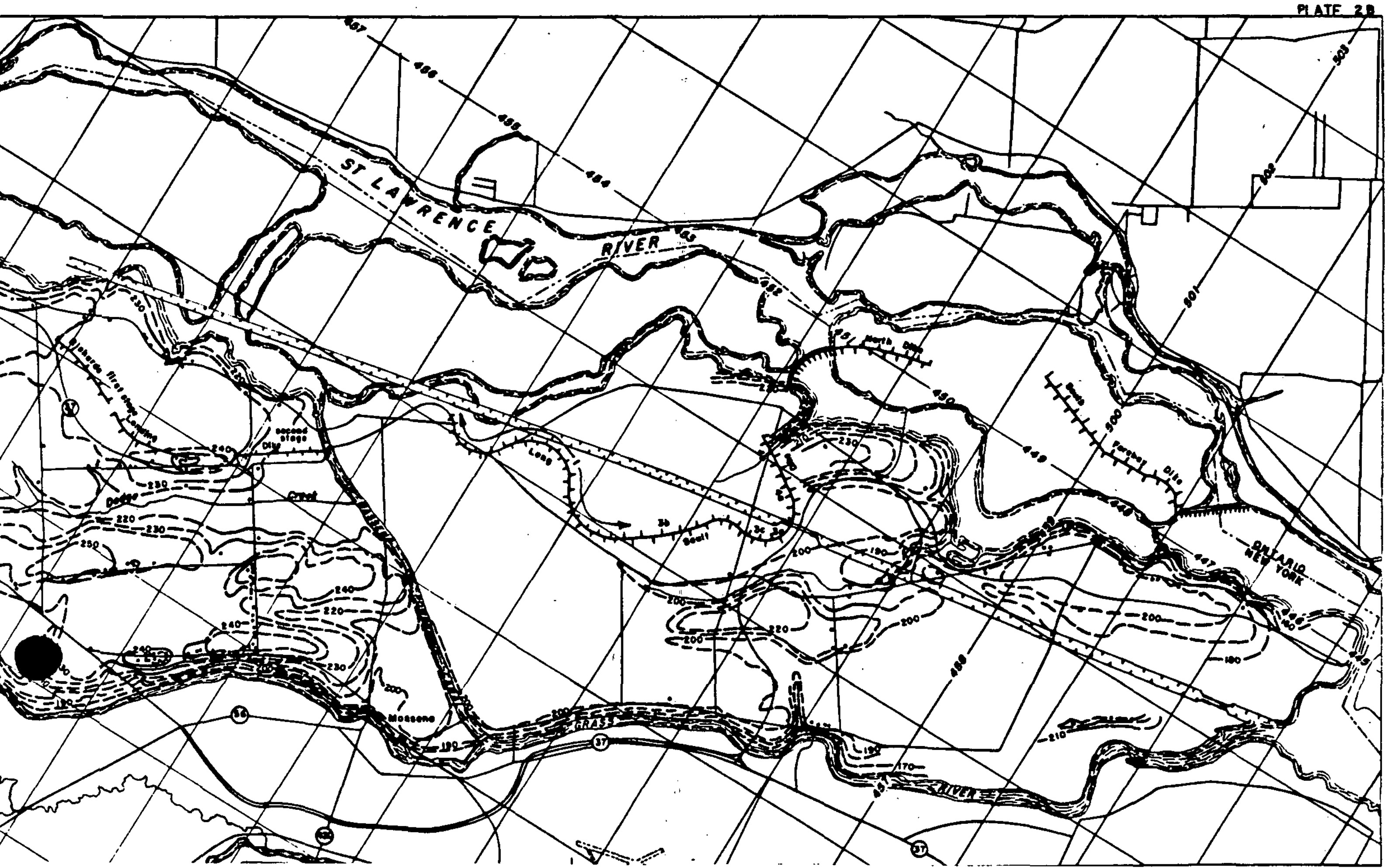
Use: A, agricultural supply (chiefly for livestock, cooling milk, and sanitation); C, commercial supply (chiefly for sanitation and service); D, domestic supply; E, subsurface exploration; I, industrial supply (chiefly for processing, cooling, sanitation, and service); M, municipal or other public supply; N, not in use; O, observation well; R, pressure-relief well.

Remarks: ALCOA, Aluminum Company of America; CE, Corps of Engineers; PASNY, Power Authority, State of New York; r, reported data; piezometer element in some observation wells is a ceramic cylinder 6 inches long; gpm, gallons per minute; gpd, gallons per day; mgd, million gallons per day; T, temperature, degrees Fahrenheit; iron, water contains a relatively high concentration of iron and commonly stains porcelain fixtures; H_2S, well yields water containing hydrogen sulfide ("sulfur water"); log, lithologic log in table 9; anal., chemical analysis in table 6.

W
Y
6

MAP OF PART OF THE MASSENA–WADDINGTON AREA, NEW YORK, SHOWING LOCATIONS OF WELLS AND SPRINGS THAT TAP UNCONSOLIDATED DEPOSITS





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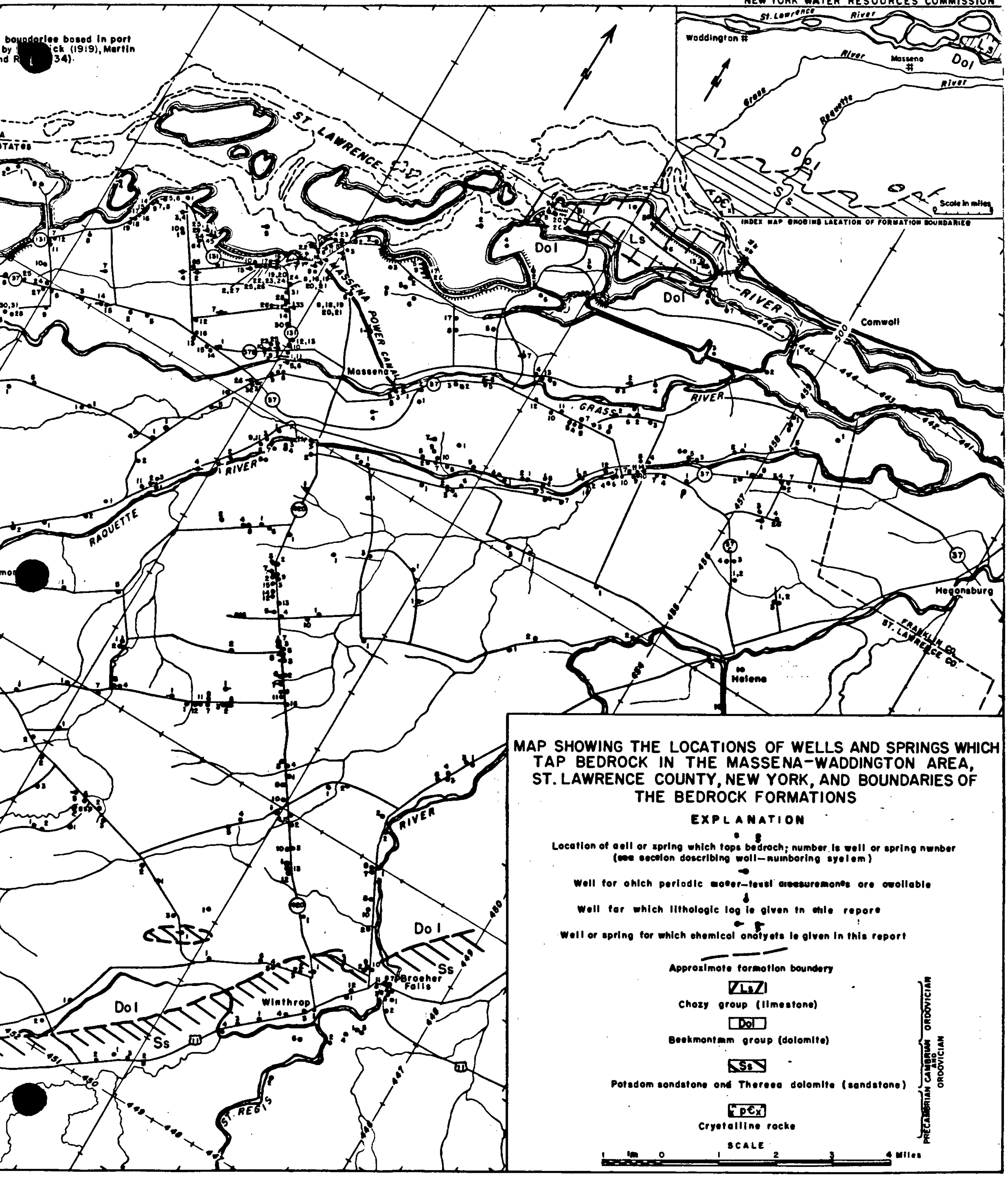


MAP SHOWING THE LOCATIONS OF WELLS AND SPRINGS WHICH TAP BEDROCK IN THE MASSENA-WADDINGTON AREA, ST. LAWRENCE COUNTY, NEW YORK, AND BOUNDARIES OF THE BEDROCK FORMATIONS

EXPLANATION

Location of well or spring which taps bedrock; number is well or spring number (see section describing well-numbering system)

Well for which periodic water-level measurements are available

Well for which lithologic log is given in this report

Well or spring for which chemical analysis is given in this report

Approximate formation boundary

Ls — Chazy group (limestone) — ORDOVICIAN

Dol — Beekmantown group (dolomite) — ORDOVICIAN

Ss — Potsdam sandstone and Theresa dolomite (sandstone) — CAMBRIAN AND ORDOVICIAN

pЄx — Crystalline rocks — PRECAMBRIAN

SCALE

1 0 1 2 3 4 Miles

New York State Atlas of
Community Water System Sources
1982

NEW YORK STATE DEPARTMENT OF HEALTH
DIVISION OF ENVIRONMENTAL PROTECTION
BUREAU OF PUBLIC WATER SUPPLY PROTECTION

Reference 4.1

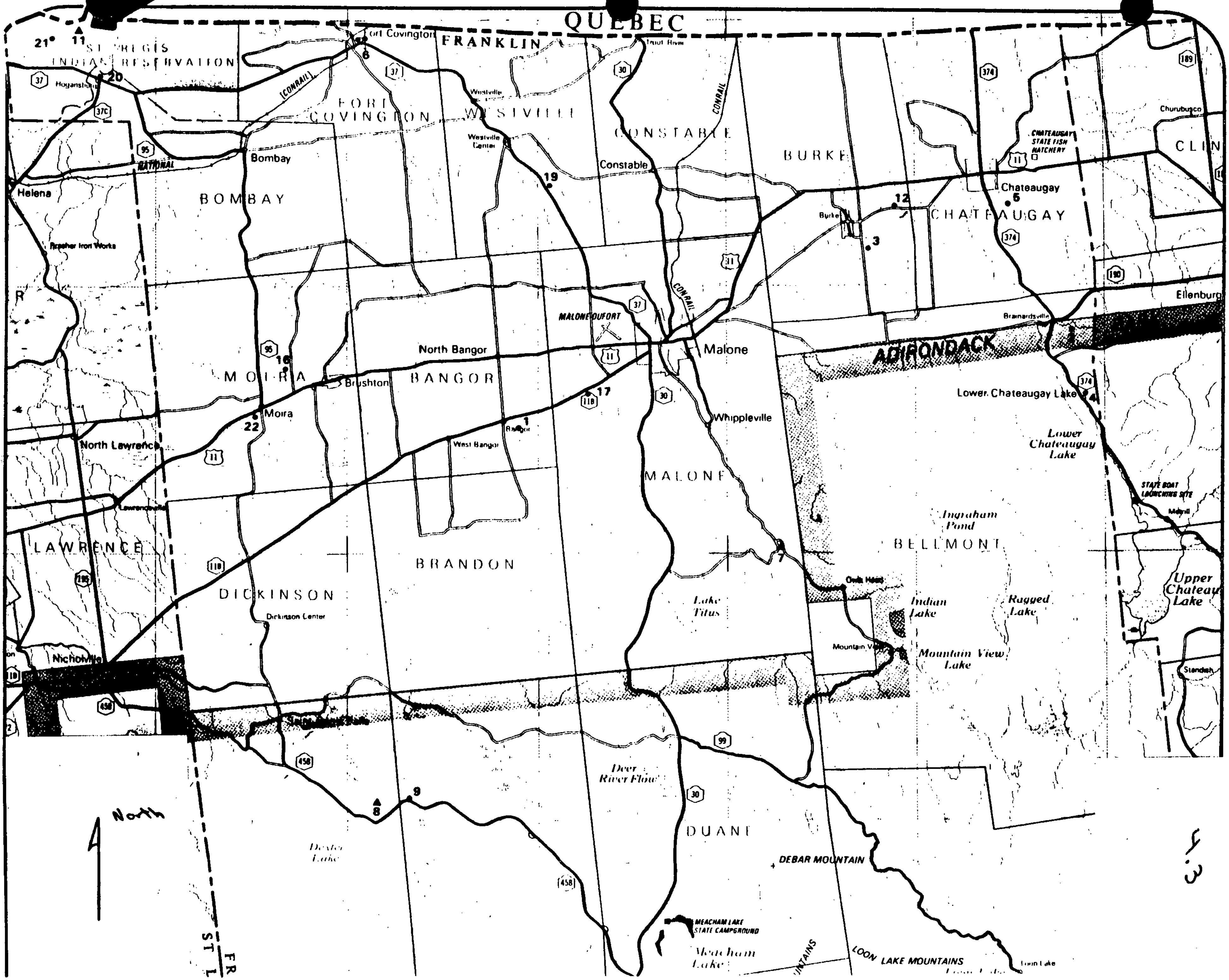
FRANKLIN COUNTY

4.2

ID NO	COMMUNITY WATER SYSTEM	POPULATION	SOURCE
Municipal Community			
1	Bangor Water District	300.	Wells
2	Brainardsville Water District	240.	Wells
3	Burke Water Company	273.	Wells
4	Chateaugay Narrows Water Works	100.	Wells
5	Chateaugay Village	1100.	Wells
6	Fort Covington Water District	900.	Wells
7	Malone Village	8863.	Salmon River, Wells (Springs)
8	Saint Regis Falls Water District	950.	Clear Pond
9	Santa Clara Water Supply	60.	Wells
10	Saranac Lake Village (See also No 23 Essex Co. Page 46)	7500.	Lake Flower
11	St. Rsgis Mohawk Water System	100.	St. Lawrence River
12	Thayer's Corners Water District	NA.	Wells
13	Tupper Lake Village	6134.	Little Simon & Cranberry Ponds, Tupper Lake
Non-Municipal Community			
14	Airport Trailer Park	NA.	Wells
15	Asplin Homes Inc.	NA.	Wells
16	Countryside Community Trailer Park	48.	Wells
17	Evergreen Manor Trailer Park	NA.	Wells
18	Paul Smith's College	1500.	Lower St. Regis Lake, Wells
19	Pine Grove Trailer Park	39.	Wells
20	Reynomes Trailer Court	21	Wells
21	St. Lawrence Trailer Court	54.	Wells
22	West Moira Mobile Home Park	36	Wells

LOCATION OF COMMUNITY WATER SYSTEM SOURCES-1982

Area of Interest

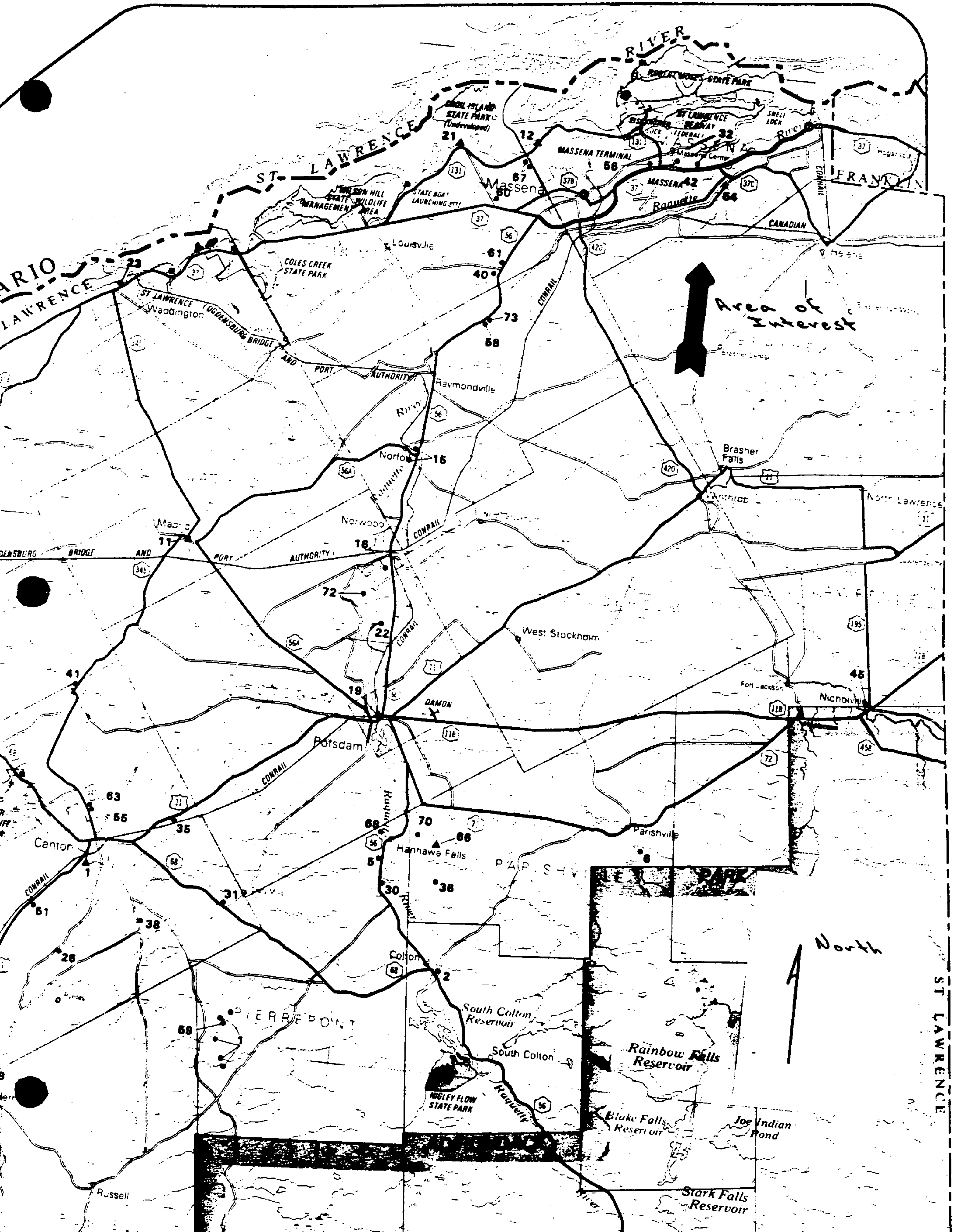


ADAPTED FROM THE FOUR-SHEET 1:250,000 SCALE NEW YORK STATE MAP © 1980 BY THE NEW YORK STATE DEPARTMENT OF TRANSPORTATION.

ST. LAWRENCE COUNTY

4.4

ID NO	COMMUNITY WATER SYSTEM	POPULATION	SOURCE
	Municipal Community		
1	Canton Village	10000	Grass River, Wells (Upland Supply)
2	Colton Water District #1	530	Wells
3	Conifer Water District Lower Supply	80	Springs
4	Conifer Water District Upper Supply	80	Springs
5	Crestview Subdivision	70	Wells
6	Crystal Spring Water Association	50	Wells (Springs)
7	Edwards Village	570	Wells
8	Gouverneur Village	4285	Oswegatchie River
9	Hermon Village	500	Wells (Springs)
10	Heuvelton Village	825	Wells
11	Madrid Water District	800	Grass River
12	Massena Village	15000	St. Lawrence River
13	Morristown Village	550	St. Lawrence River
14	Newton Falls	550	Oswegatchie River
15	Norfolk Water District #1	1200	Wells
16	Norwood Village	2200	Wells
17	Ogdensburg City	12375	St. Lawrence River
18	Piercefield Water District	225	Raquette River
19	Potsdam Village	10635	Raquette River
20	Star Lake Water District	1100	Star Lake
21	Tucker Terrace Water Corporation	120	St. Lawrence River
22	Unionville Water District	220	Wells
23	Waddington Village	1055	Wells
24	Wanakena Water Company Inc	175	Wells (Springs)
25	Woodhaven Water District	70	Wells
26	Woodmere Subdivision	20	Wells
	Non-Municipal Community		
27	Armes Trailer Court	63	Wells
28	Barker's Mobile Home Colony	4S	Springs
29	Birch Mountain Mobile Home Park	25	Wells
30	Bob Scott's Trailer Park	72	Wells
31	Bnyden Brook Mobile Home Park	42	Wells
32	Burnham's Trailer Park	27	Wells
33	Cedars Nursing Home	84	Wells
34	Cedar's Trailer Court	25	Wells
35	Champion Home Communities	120	Wells
36	Charleson's Trailer Park	25	Wells
37	Circle Inn Trailer Park	21	Wells
38	Clark's Trailer Park	54	Wells
39	Country Lane Trailer Park	66	Wells
40	Fregoe's Trailer Park	NA	Wells
41	Hasting's Place	32	Wells
42	Hometown Trailer Court	25	Wells
43	Jolly K Mobile Home Park	36	Wells
44	Liscum's Trailer Park	62	Wells
45	Lucas' Store	9	Wells
46	M & M Trailer Park	42	Wells
47	Mallott's Camps	NA	Wells
48	Mater Dei College	250	Wells
49	Morley's Mobile Home Park	90	Wells
50	Morning Star Homes Inc	175	Wells
51	Peter's Park	141	Wells
52	Phelps Trailer Park	33	Wells
53	Pleasant View Trailer Court	18	Wells
54	Riverview Trailer Court	25	Wells
55	Ruady's Trailer Court	25	Wells
56	Seaway Kampground	50	Wells
57	Shaoy Acre Trailer Park	27	Wells
58	Shamrock Trailer Court	30	Wells
59	Sharlows Trailer Park	20	Wells
60	Sherwood Trailer Court	60	Wells
61	Short's Trailer Park	125	Wells
62	Sleepy Acres Motel	70	Wells
63	Todd's Trailer Court	51	Wells
64	Wadhams Hill Seminary College	NA	Wells
65	Wanakena State Ranger School	100	Wells
66	West Parishville Trailer Park	33	Springs
67	Westbrook Courts	100	Wells
68	Whitebirch Mobile Home Village	78	Wells
69	Wilmot Mobile Home Park	30	Wells
70	Woodhue Court	25	Wells
71	Woods Trailer Park	15	Wells
72	Woodward's Trailer Park	20	Wells
73	Young's Trailer Court	10	Wells


ST. LAWRENCE RIVER
ONTARIO
ROBERT MOSES STATE PARK
ST LAWRENCE SEAWAY
SNELL LOCK
MASSENA TERMINAL
Massena
MASSENA
Raquette
CANADIAN
FRANKLIN
WILSON HILL STATE WILDLIFE MANAGEMENT AREA
STATE BOAT LAUNCHING SITE
COLES CREEK STATE PARK
Louisville
Waddington
ST LAWRENCE (OGDENSBURG BRIDGE AND PORT AUTHORITY)
Raymondville
Norfolk
Norwood
CONRAIL
Brasher Falls
Helena
Area of Interest
North Lawrence
Madrid
OGDENSBURG BRIDGE AND PORT AUTHORITY
West Stockholm
DAMON
Potsdam
Nicholville
Fort Jackson
Canton
Hannawa Falls
Parishville
PARISHVILLE
Colton
South Colton Reservoir
South Colton
PIERREPONT
Rainbow Falls Reservoir
HIGLEY FLOW STATE PARK
Blake Falls Reservoir
Joe Indian Pond
Stark Falls Reservoir
Russell
North
ST LAWRENCE

Reference 5.1

New York State Department of Environmental Conservation
50 Wolf Road, Albany, New York 12233-0001

Henry G. Williams
Commissioner

July 24, 1985

MEMORANDUM

TO: Bureau Directors, Regional Water Engineers, Section Chiefs

SUBJECT: Division of Water Technical and Operational Guidance Series (85-W-38)

Ambient Water Quality Standards and Guidance Values
(Originator: John Zambrano)

I. Purpose

The purpose of this document is to provide a compilation of water quality standards and guidance values for toxic and non-conventional pollutants to be used in the Department's regulatory programs, including the SPDES permit program.

II. Discussion

This substantial revision of TOGS 85-W-38 is the result of the promulgation of amendments to 6 NYCRR Part 701-702, effective on August 2, 1985, governing the development and use of surface water quality standards and guidance values. This revision uses a new format in the tabulation and does not include the methodologies for the development of standards and guidance values. The user is referred to the regulations for a description of the methodologies.

III. Guidance

The Quality Evaluation Section will use the attached list in developing SPDES permit water quality-based effluent limits. The Criteria and Standards Section will maintain and revise the list on a regular basis.

for Daniel M. Barolo, P.E.
Director
Division of Water

Attachments
cc: Dr. Banks
Mr. Pagano
Mr. Mt. Pleasant
Regional Engineers for Environmental Quality
Ms. Chrimes

AMBIENT WATER QUALITY STANDARDS AND GUIDANCE VALUES

The attached tabulation of Water Quality Standards and Guidance Values provide the ambient pollutant concentrations which have been developed to protect New York State waters for their best classified usage. They are used by the Department in the regulatory process of establishing SPDES permit water quality-based effluent limits and in the evaluation of ambient water quality data. An explanation of the tabulation, including guidance on its use, is provided below. Following the tabulation is an alphabetical index of substances with corresponding page number.

A. Water Quality Standards

Water quality standards for surface waters are given in the tabulation and are cited in the recently amended 6 NYCRR Part 701 regulations. These standards were developed as per the methodologies contained in the regulations. Groundwater standards are also listed and were obtained from existing regulations (Part 703).

B. Water Quality Guidance Values

Water quality guidance values are also given in the list. Methodologies for their development and use are part of the amended regulations governing surface water quality and are equivalent to the methodologies for standards. The Department has determined that these methodologies are also appropriate for the development and use of groundwater guidance values. All listed guidance values, therefore, were developed by the methodologies cited in amended Part 701.

As additional chemical substances receive sufficient Department review, guidance values will be developed for use in the regulatory process as per the authority of 6 NYCRR Part 701.15. For any chemical for which an ambient water quality guidance value has been derived, the Department will initiate rulemaking to adopt an ambient water quality standard.

C. Type, Water Classes and Notes

Two types of standards and guidance values are listed. "Human" type values are based on health concerns relative to potable water, and "Aquatic" type values were developed for the protection of aquatic life. Human and aquatic categories are designated under column heading "TYPE" by the letters H and A, respectively.

Standards and guidance values are further categorized according to New York State's water classification system. Pertinent surface water quality classes are described in Table 1.

The specific methodology or basis used to develop a standard or guidance value Is designated by a letter under the "NOTES" column of the tabulation. Table 2 defines these notes according to the category, NYCRR reference and methodology or basis for development. The hydrologic flow base and effluent

Table 1. Summary of Water Quality Classifications
(See 6 NYCRR Part 701 for detailed explanation)

	Class	Best Usage	Conditions Related To Best Usage
Surface Water (Fresh)	D	Secondary contact recreation (only)	Fish survival
	C	Fishing, and D	Fish survival and propagation
	B	Primary contact recreation and C	
	A	Drinking water supply, food processing and B	Meets drinking water standards with treatment and disinfection
	AA	Drinking water supply, food processing and B	Meets drinking water standards with disinfection only
	A-S	Best usage same as in A Classification (Great Lakes Water Quality Agreement)	
	AA-S	Any use except disposal of sewage, industrial wastes or other wastes (Champlain Drainage Basin)	
Surface Water (Saline)	SD	Not for recreational purposes, shellfish culture, or development of fishlife due to natural or man-made conditions	
	SC	Fishing, except for shellfish for market purposes	
	SB	Primary and secondary contact recreation and SC	
	SA	Shellfishing for market purpose and SB	
	I	Secondary contact recreation and other uses except primary contact recreation and shellfishing for market purposes (Interstate Sanitary District)	
Groundwater (Fresh)	GA	Source of potable water supply	

Table 2. Notes To Standards And Guidance Value Listings

Consideration	Note	NYCRR Reference	Methodology for Establishing Standard Or Guidance Value	Surface Hydrologic Flow Base	Effluent Limit Calculation	Comment
Human (Surface Water)	A	701.4	Oncogenic	MA30CD/10	Monthly average	Cancer risk
	B	701.5	Non-oncogenic	MA30CD/10	Monthly average	Toxicity based
	C	701.6	Aesthetic	MA30CD/10	Monthly average	Taste & odor
	D	701.7	Chemical correlation	---	---	Same as chemical used for correlation
	E	701.15(e)	50 ug/l individual parameter	MA30CD/10	Monthly average	Gen. Org. Chem. Cat.
Aquatic (Surface Water)	H	701.8(b)	USEPA published criteria	MA7CD/10 (generally)	---	Acute or chronic tox. available
	I	701.9(a)	Propagation (chronic toxicity)	MA7CD/10	Maximum daily	Chronic tox. tests
	J	701.9(b)	Propagation (chronic toxicity)	MA7CD/10	Maximum daily	Chronic toxicity tests not available
	K	701.10	Survival (acute toxicity	MA7CD/10	Maximum daily	-----
	L	701.11	Aquatic food tainting	MA30CD/10	Monthly average	Taste & odor
	M	701.12	Bioaccumulation	MA30CD/10	Monthly average	-----
	N	701.13	Chemical S aquatic species correlation	---	---	Same as D
Human						
(Surface Water)	Q	10 NYCRR NYSDOH Part 5		MA30CD/10	Monthly average	Potable water supplies
(Surface Water)	R	10 NYCRR NYSDOH Part 170		MA30CD/10	Monthly average	Sources of water supplies
(Groundwater)	S	Part 703.53 NYSDEC		---	Maximum daily	Groundwater regulations

limit calculation to be used for each substance in developing a SPDES effluent limit are also given.

D. Miscellaneous

1. Chemical Abstract Service (CAS) Numbers

The substances listed in the tabulation can be described by other names. Chemical Abstract Service numbers are provided where appropriate, to assist in determining the applicability of listed substances to synonymous chemical names.

2. Hardness

Hardness is the sum of the calcium and magnesium concentrations expressed as mg/l of $CaCO_3$. The hardness of the receiving water has a distinct effect on the toxicity of certain substances. Where applicable, the appropriate formula is provided to calculate the standard or guidance value using hardness.

3. Hydrologic Flow Base

A consistent, clearly understood, written guidance to the methodology of selecting hydrologic flow base figures is important to the permit development process. Representatives of NYSDEC and the NYSDOH developed the recommended flow base requirements to be used in setting permit limits. In general, for substances having standards or guidance values based on acute or chronic aquatic toxicity, MA7CD/10 stream flow should be used to develop maximum daily effluent limits. Chemical effects of pollutants on aquatic life are not generally based on average lifetime intake. Chronic effect levels on aquatic life are generally considered those which result in lethal toxicity at some sensitive life stage or perhaps the lethal toxic effect resulting from a 10 to 30 day exposure of juveniles or adult organisms. Since the sensitive life stage may occur at low flow periods or a chronic effect could occur within 30 days, it is appropriate to use the MA7CD/10 streamflow when effluent limits are based on water quality criteria developed for aquatic toxicity. Where human health concerns are the consideration, MA30CD/10 flow base is generally used to develop monthly average effluent limits. The appropriate flow bases to be used in connection with the standards and guidance values are given in Table 2.

4. Total of Organic Chemicals

In developing a SPDES permit for a surface water discharge with human health concerns , a 100 ug/l maximum ambient water quality value is required for the total of designated organic chemicals. Organics with standards or guidance values are included in this total. The 100 ug/l maximum value will similarly be used for groundwater discharge permits. On the attached list, the symbol (§) preceding a chemical designates it as being included in the total organic chemical category. As described in the Part 701 regulations, substances with standards or guidance values greater than 100 ug/l are not included in the total.

5. Acid Soluble Form

The acid soluble form of a substance is defined as that part of the substance that passes through a 0.45 micron membrane filter after the sample is acidified to pH 1.5 to 2.0 with nitric acid.

6. Isomers and Chemical Combinations

The standards and guidance values tabulation contains numerous cases of combinations, groups, or isomers of the same chemical species. Whether or not a chemical group, congeners or multiple substances are indicated in the tabulation to be summed, the standard or guidance value does apply to the sum of those substances. Where isomers are specified, the remarks in the tabulation always indicate which isomers are to be included in the sum.

7. Concurrent Standards and Guidance Values

For a given substance, Water Classes A, AA, A-S and AA-S may concurrently list both a human and an aquatic type standard or guidance value. The result can be two standards, two guidance values or one standard and one guidance value. In all three situations, the more stringent value is used when developing water quality-based effluent limits.

The previous versions of this document concurrently listed for certain substances a standard and guidance value for the same water class and type with the instructions that the standard takes precedence. The guidance value was listed for information purposes. This version does not concurrently list a standard and guidance value for the same water class and type.

5.7

NEW YORK STATE AMBIENT WATER QUALITY STANDARDS AND GUIDANCE VALUES

Date of Revision: July 24, 1985

SUBSTANCE (CAS NO.)	WATER CLASSES	MICROGRAMS/LITER STANDARD	MICROGRAMS/LITER GUIDANCE VALUES	TYPE	NOTES
§	A, A-S, AA, AA-S		50	H	E
Methyl chloride	GA		50	H	E
(74-87-3)	A, A-S, AA, AA-S, B, C			A	
	D			A	
	SA, SB, SC			A	
	I			A	
	SD			A	
§	A, A-S, AA, AA-S		50	H	E
Methylene bisthiocyanate	GA		50	H	E
(6317-18-6)	A, A-S, AA, AA-S, B, C	1.0		A	J
	D			A	
	SA, SB, SC			A	
	I			A	
	SD			A	
§	A, A-S, AA, AA-S		50	H	E
Methylene chloride	GA		50	H	E
(75-09-2)	A, A-S, AA, AA-S, B, C			A	
	D			A	
	SA, SB, SC			A	
	I			A	
	SD			A	
§	A, A-S, AA, AA-S		50	H	E
4-(1-Methylethoxy)-1-butanol	GA		50	H	E
(31600-69-8)	A, A-S, AA, AA-S, B, C			A	
	D			A	
	SA, SB, SC			A	
	I			A	
	SD			A	
§	A, A-S, AA, AA-S		50	H	E
2-Methylethyl-1,3-dioxolane	GA		50	H	E
(126-39-6)	A, A-S, AA, AA-S, B, C			A	
	D			A	
	SA, SB, SC			A	
	I			A	
	SD			A	
S	A, A-S, AA, AA-S			H	
Methyl methacrylate	GA	700*		H	S
(80-62-6)	A, A-S, AA, AA-S, B, C			A	
	D			A	
	SA, SB, SC			A	
	I			A	
	SD			A	

Remarks: * Methyl Methacrylate not Included In 100 ug/l summation criterion for Class GA.

SUBSTANCE (CAS NO.)	WATER CLASSES	STANDARD	GUIDANCE VALUES	TYPE	NOTES
§	A, A-S, AA, AA-S		0.04	H	A
Mirex	GA		0.04	H	A
(2365-85-5)	A, A-S, AA, AA-S, B, C	0.001		A	H
	D	0.001		A	H
	SA, SB, SC	0.001		A	H
	I		0.001	A	H
	SD		0.001	A	H

5.8

NEW YORK STATE AMBIENT WATER QUALITY STANDARDS AND GUIDANCE VALUES

Date of Revision: July 24, 1985

SUBSTANCE (CAS NO.)	WATER CLASSES	MICROGRAMS/LITER STANDARD	MICROGRAMS/LITER GUIDANCE VALUES	TYPE	NOTES
§ Phenyl ether (101-84-8)	A, A-S, AA, AA-S	10		H	C
	GA		10	H	C
	A, A-S, AA, AA-S, B, C			A	
	D			A	
	SA, SB, SC			A	
	I			A	
	SD			A	
§ Phenylpropanol-amine (14838-15-4)	A, A-S, AA, AA-S		50	H	E
	GA		50	H	E
	A, A-S, AA, AA-S, B, C			A	
	D			A	
	SA, SB, SC			A	
	I			A	
	SD			A	
§ Phorate & Disulfoton (298-02-2; 298-04-4)	A, A-S, AA, AA-S			H	
	GA	ND		H	S
	A, A-S, AA, AA-S, B, C			A	
	D			A	
	SA, SB, SC			A	
	I			A	
	SD			A	
Remarks: ND - Not Detectable.					
§ Polychlorinated biphenyl, PCB (NA)	A, A-S, AA, AA-S	0.01		H	A
	GA	0.1		H	S
	A, A-S, AA, AA-S, B, C	0.001		A	H
	D	0.001		A	H
	SA, SB, SC	0.001		A	H
	I		0.001	A	H
	SD	0.001		A	H
§ Propachlor (1918-16-7)	A, A-S, AA, AA-S			H	
	GA	35.0		H	S
	A, A-S, AA, AA-S, B, C			A	
	D			A	
	SA, SB, SC			A	
	I			A	
	SD			A	
§ Propanil (709-98-8)	A, A-S, AA, AA-S			H	
	GA	7.0		H	S
	A, A-S, AA, AA-S, B, C			A	
	D			A	
	SA, SB, SC			A	
	I			A	
	SD			A	
§ Propazine (139-40-2)	A, A-S, AA, AA-S			H	
	GA	16.0		H	S
	A, A-S, AA, AA-S, B, C			A	
	D			A	
	SA, SB, SC			A	
	I			A	
	SD			A	

Reference 6.1

NYSDEC Region 6, Darrell Sweredoski

Personal Communication, 1987

Interview Form

Interviewee: Darrell Sweredoski

Title - Position: Sr. Sanitary Engineer

Address: NYSDEC Region 6 Office - 317 Washington Street

City/State/Zip: Watertown, New York 13601

Phone: (315) 785-2236

Date: June 1987 Interviewed by: Wm. Shaw

Subject: St Lawrence - Grasse River System Scoring

In a telephone interview the following information was disclosed:

* PCBs were historically released to the defined St Lawrence - Grasse River Site by means of the erosion of contaminated soils (with adsorbed PCBs) and surface drainage from areas where sludges containing PCBs were stored or landfilled.

* The defined site includes a portion of the St Lawrence River which is a critical habitate for the Bald Eagle (wintering ground).

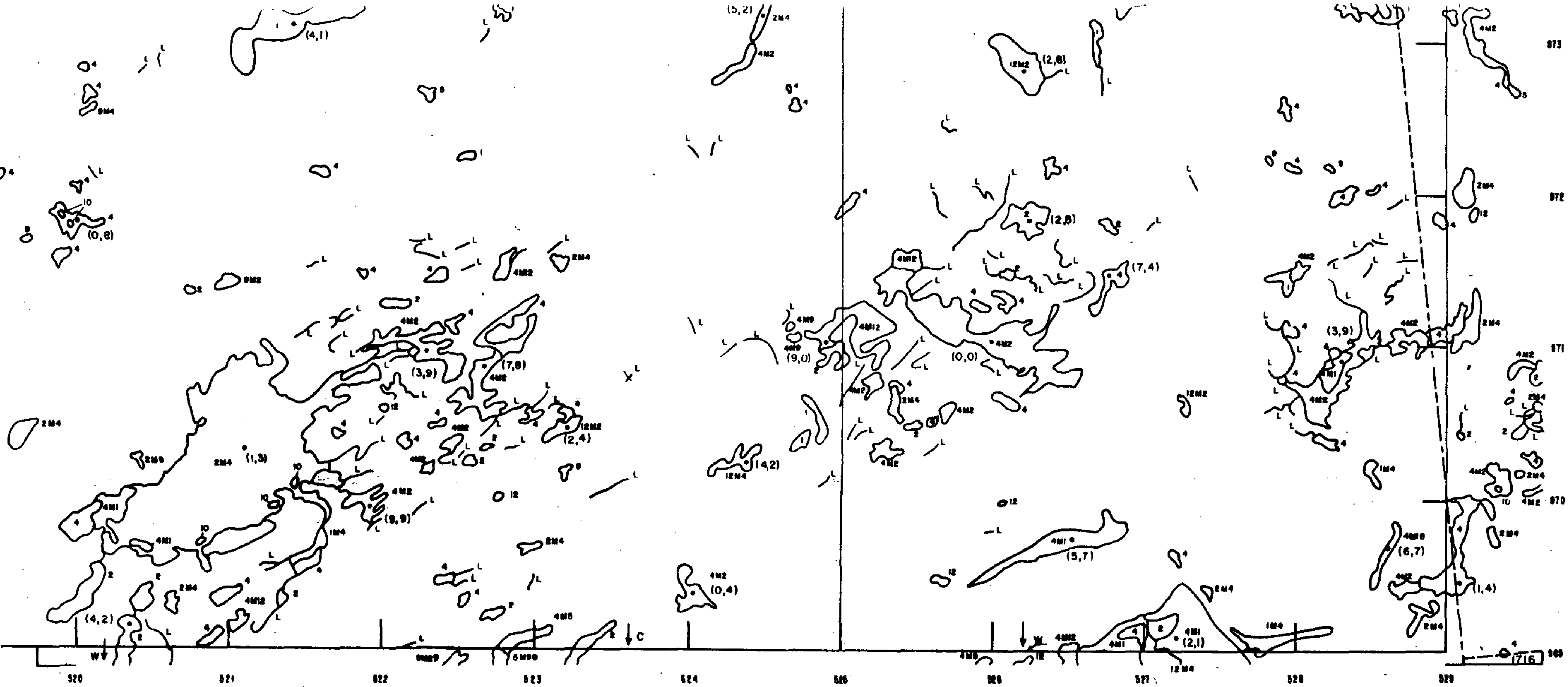
I agree with the above interview summary:

Signature: Darrell M. Sweredoski

Title: Senior Sanitary Engineer

Date: Aug 5, 1987

Comments:



NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION

DIVISION OF FISH & WILDLIFE

AIR PHOTO INTERPRETATION AND MAPPING PERFORMED BY THE WILDLIFE HABITAT MANAGEMENT SECTION, BUREAU OF WILDLIFE, DIVISION OF FISH & WILDLIFE, DEPARTMENT OF ENVIRONMENTAL CONSERVATION.
INVENTORY DESIGNED BY THE WILDLIFE HABITAT MANAGEMENT SECTION, BUREAU OF WILDLIFE, DIVISION OF FISH & WILDLIFE, DEPARTMENT OF ENVIRONMENTAL CONSERVATION AND THE RESOURCE INFORMATION LABORATORY, CORNELL UNIVERSITY.

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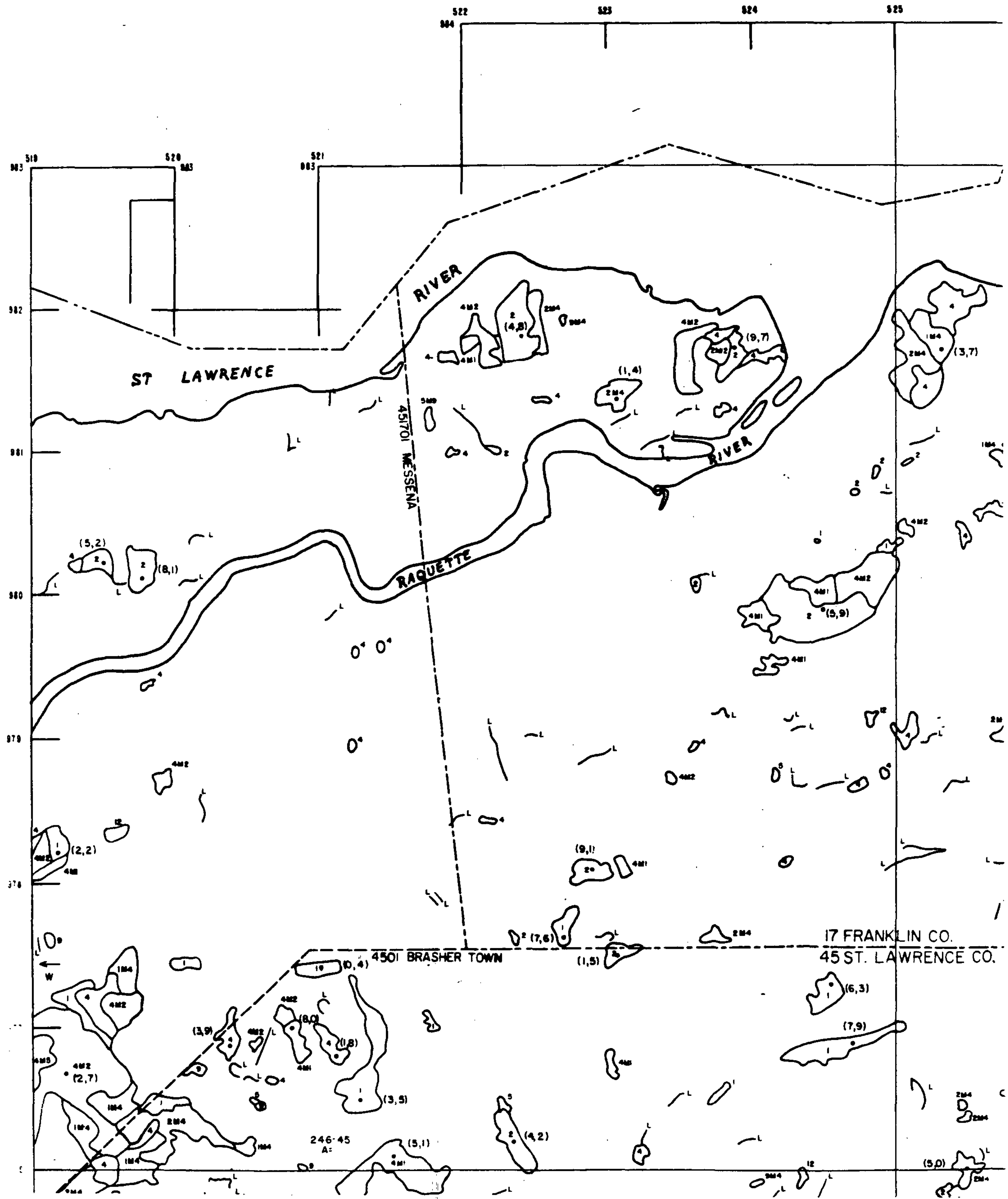
NEW YORK STATE WETLANDS INVENTORY												ZONE 18
QUAD NAME HOGANSBURG						LUNR NO. 4745		SCALE: 1:24,000		7 1/2 NYSDOT TOPO 1969 MAP OVERLAY		
PHOTOGRAPHY DATE/SOURCE	COUNTY FRANKLIN				COUNTY ST. LAWRENCE				COUNTY			
	SUMMER				SUMMER				SUMMER			
	SOURCE				SOURCE				SOURCE			
	SPRING 4-16-64				SPRING				SPRING			
	SOURCE LUNR				SOURCE				SOURCE			
STATUS	INITIAL	CHECK	DTO	DRAFT	INITIAL	CHECK	DTO	DRAFT	INITIAL	CHECK	DTO	DRAFT

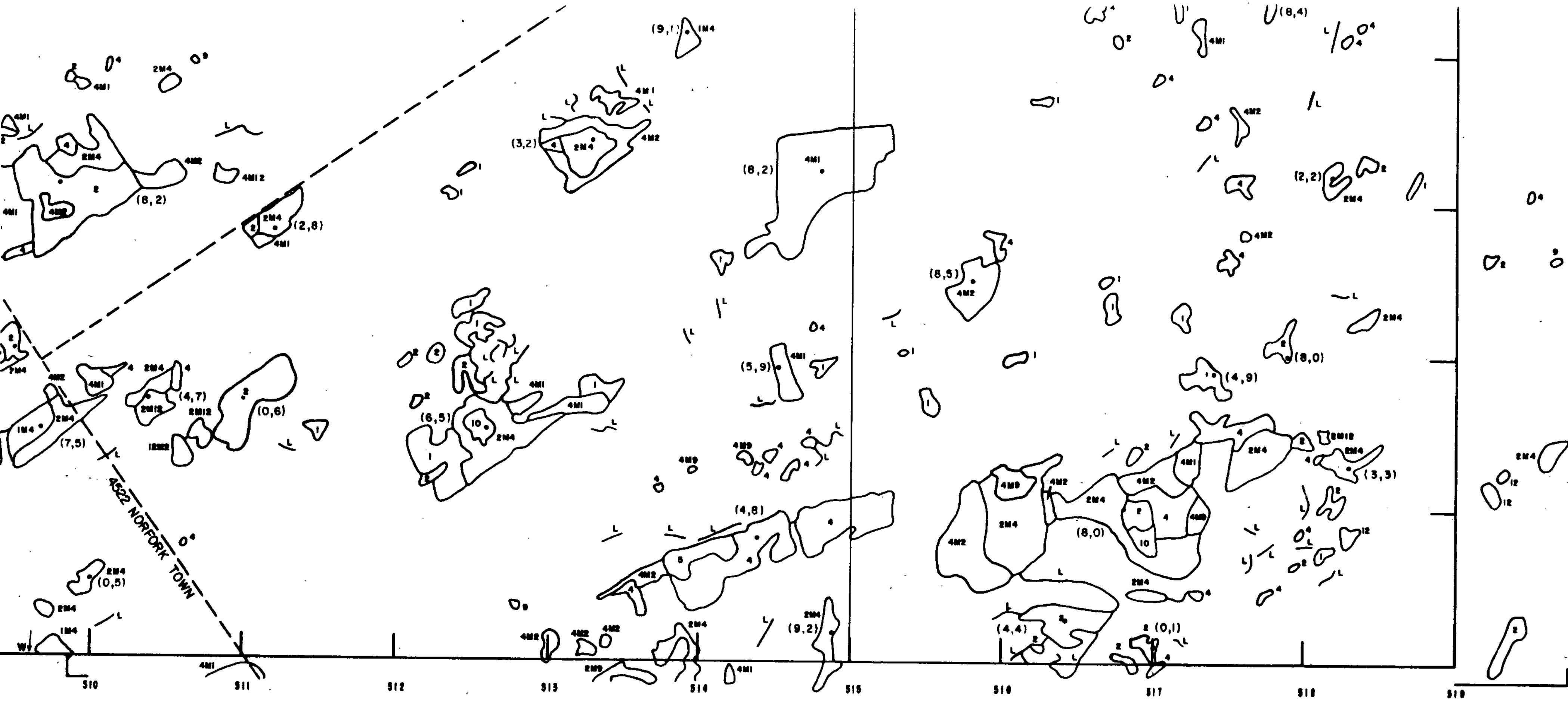
Reference 7.1

7.2

Hogansburg

ATTENTION: THIS WETLAND OVERLAY IS NOT AN OFFICIAL DEPARTMENT OF ENVIRONMENTAL CONSERVATION REGULATORY MAP UNDER THE FRESHWATER WETLANDS LAW.





NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION

DIVISION OF FISH & WILDLIFE

AIR PHOTO INTERPRETATION AND MAPPING PREPARED BY THE WILDLIFE HABITAT MANAGEMENT SECTION, BUREAU OF WILDLIFE, DIVISION OF FISH & WILDLIFE, DEPARTMENT OF ENVIRONMENTAL CONSERVATION.

INVENTORY DESIGNED BY THE WILDLIFE HABITAT MANAGEMENT SECTION, BUREAU OF WILDLIFE, DIVISION OF FISH & WILDLIFE, DEPARTMENT OF ENVIRONMENTAL CONSERVATION AND THE RESOURCE INFORMATION LABORATORY, CORNELL UNIVERSITY.

SUPPORT WAS PROVIDED BY FEDERAL AID IN FISH AND WILDLIFE RESTORATION FUNDS (PROJECT W-140-R), ADMINISTERED AT THE FISH AND WILDLIFE SERVICE, UNITED STATES DEPARTMENT OF INTERIOR. SELECTED PORTIONS OF THE INVENTORY WERE ALSO AIDED BY THE OFFICE OF COASTAL ZONE MANAGEMENT, NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION, UNITED STATES DEPARTMENT OF COMMERCE, UNDER THE COASTAL ZONE MANAGEMENT ACT, AT THE ADIRONDACK PARK AGENCY AND BY THE TEMPORARY STATE COMMISSION ON TUG HILL.

NEW YORK STATE WETLANDS INVENTORY					ZONE 18
QUAD NAME RAQUETTE RIVER		LUMR NO 4746	SCALE 1:24,000		T/E NYSDOT TOPO MAP OVERLAY 1988

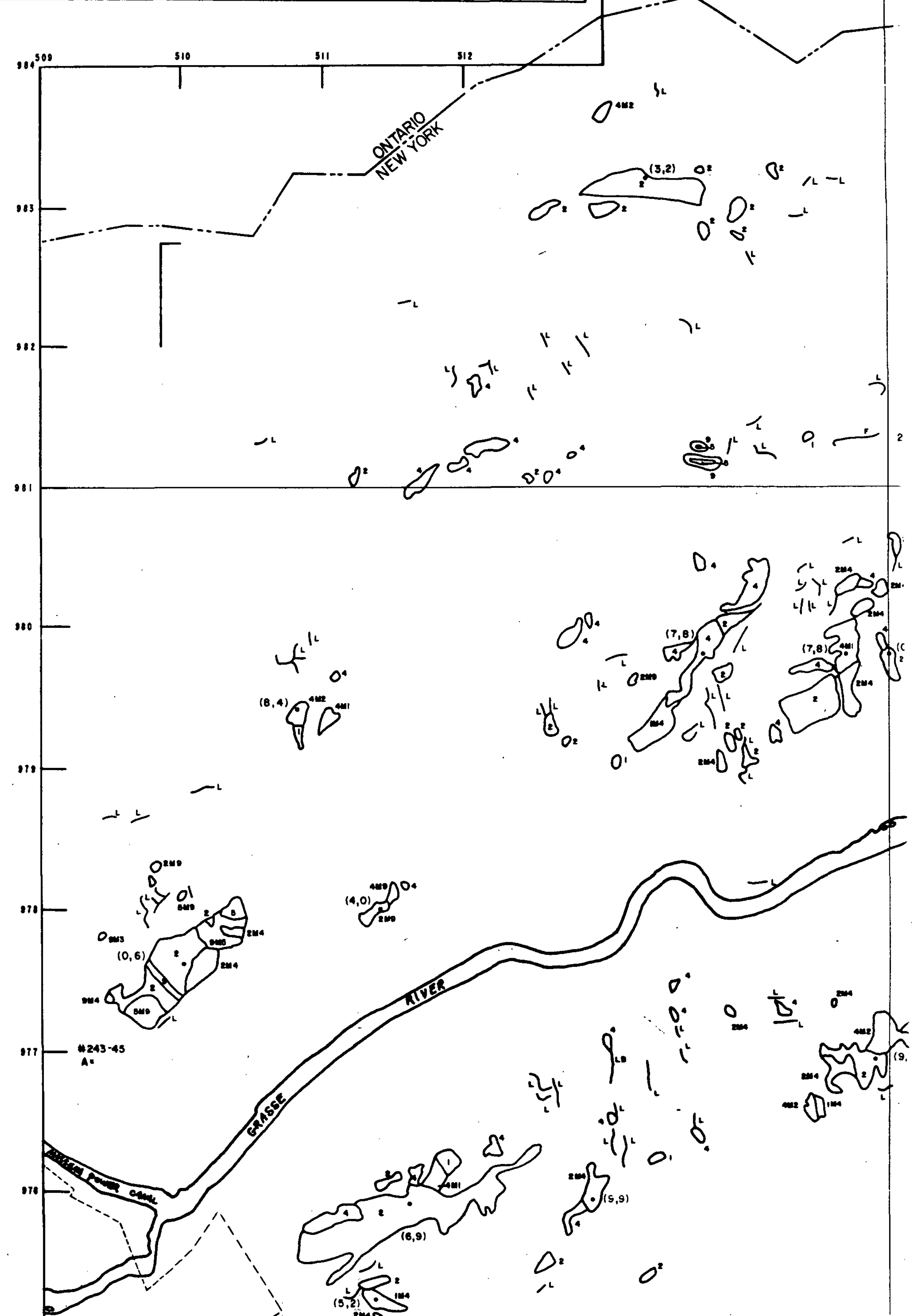
	COUNTY ST. LAWRENCE	COUNTY	COUNTY
PHOTOGRAPHY DATE/SOURCE	SUMMER NO SUMMER	SUMMER	SUMMER
	SOURCE	SOURCE	SOURCE
	SPRING 4-19-68	SPRING	SPRING
	SOURCE LUNR	SOURCE	SOURCE

STA-TUS	INITIAL	CHECK	DTO	DRAFT	INITIAL	CHECK	DTO	DRAFT	INITIAL	CHECK	DTO	DRAFT

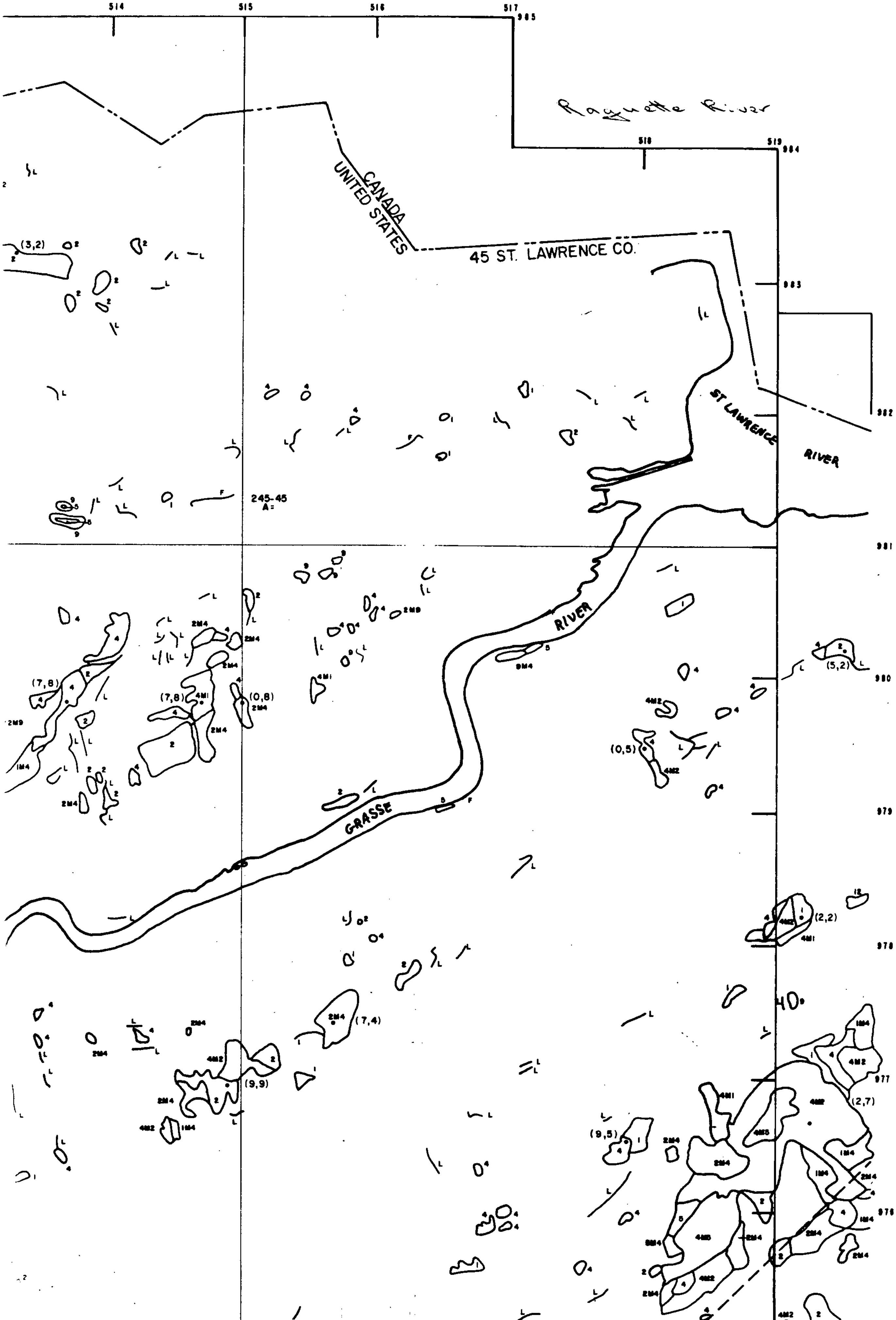
Raquette River

7.4

ATTENTION: THIS WETLAND OVERLAY IS NOT AN OFFICIAL DEPARTMENT OF ENVIRONMENTAL CONSERVATION REGULATORY MAP UNDER THE FRESHWATER WETLANDS LAW.



7.5


514
515
516
517
985
Raquette River
518
519
984
CANADA
UNITED STATES
45 ST. LAWRENCE CO.
983
ST LAWRENCE
RIVER
982
245-45
981
RIVER
980
979
GRASSE
978
977
976
(3,2)
(7,8)
(7,8)
(0,8)
(0,5)
(5,2)
(2,2)
(7,4)
(9,9)
(9,5)
(2,7)

URBAN WILDLIFE HABITAT INVENTORY MAP OVERLAY USER INFORMATION

Habitat Inventory Unit - Urban Wildlife Environments Program
Bureau of Environmental Protection - Bureau of Wildlife
Division of Fish & Wildlife
New York State Department of Environmental Conservation

The urban wildlife habitat inventory was undertaken as an integral part of the Bureau of Wildlife's Urban Wildlife Environments Program. The inventory planning process was started during the winter of 1976 and a pilot study of the techniques to be used was completed in the summer of 1978. After the initial planning stages of the inventory, the statewide inventory was completed by the Habitat Inventory Unit.

The inventory provides data for each of the State's seven urbanized areas : Albany-Schenectady-Troy, Binghamton, Buffalo, the New York City Metropolitan Area (Includes the five boroughs of New York City, Nassau County, the western half of Suffolk County and portions of Westchester County), Rochester, Syracuse and Utica-Rome. Data consists of vegetative covertypes and land use categories presented on map overlays. A computer data base is now being prepared to analyze the amount of available wildlife habitat within cities. The computer data base will analyze the land use and covertype information as well as 1970 census data. A separate user's guide will be prepared for the computer system. Covertyping information, derived from stereo aerial photography gives all existing categories of vegetaion as of the date of photography. Land use information is also correct as of the date of photography. Quality of the airphotos used was variable. Field checks were conducted in most cities to determine the accuracy of the airphoto interpretation. New York City was not field checked; checking was dependent on city produced (1978 New York City Planning maps, scale 1:7,200, address on following page) land use maps. For most cities, aerial photographs were taken at a scale of 1:12000. The cities of Buffalo (1:6000) and Syracuse (1:9600), however were photographed at different scales. The decisions made for the differentiation between the various covertype and land use categories were arrived at during the pilot inventory and in some instances during the initial stages of the statewide inventory.

The areas inventoried were limited by the extent of the urban area (usually the city limits) or by the amount of available photography or money to purchase the photography. "Limit of photography" can be seen on many of the overlays.

I. Urban Wildlife Habitat Inventory Map Overlay Identification:

Each overlay has a title block in the lower right hand corner (Fig. I).

URBAN WILDLIFE HABITAT INVENTORY NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION DIVISION OF FISH AND WILDLIFE, BUREAU OF WILDLIFE, HABITAT SECTION 50 WOLF ROAD, ALBANY, NEW YORK 12233	
QUAD NAME:	DATE OF PHOTOGRAPHY:
URBANIZED AREA:	DATE OF PREPARATION:
COUNTY:	SCALE: 1:9600 – 1" = 800'
Prepared by the Habitat Inventory Unit and the Urban Wildlife Environments Unit.	

Fig. 1

The 1:9600 Department of Transportation (D.O.T.) Urban Area planimetric base map's name, information about the overlay and the photography used is given here. For New York City, the base maps used are the 1:9600 City Planning Maps. Base maps may be obtained from the following agencies:.

D.O.T. Urban Area Planimetric Maps

Map Information Unit
N.Y.S. Dept. of Transportation
State Campus, Bldg. 4, Room 105
Albany, New York 12232

New York City Planning Maps

N.Y.S. Dept. of City Planning
2 Lafayette Street
New York, New York 10007

II. Overlay Alignment:

Align overlay by placing neat line corner marks (Fig. 2) over the outside borders of the base map. Note: The NYTM (New York Transverse Mercator) grid does not correspond to the outside border of the base map. The NYTM is the extended zone 18 of the UTM (Universal Transverse Mercator). Grid ticks on the NYTM and UTM match; however, the numbers are different, that is, continuous in both directions instead of breaking into a new zone.

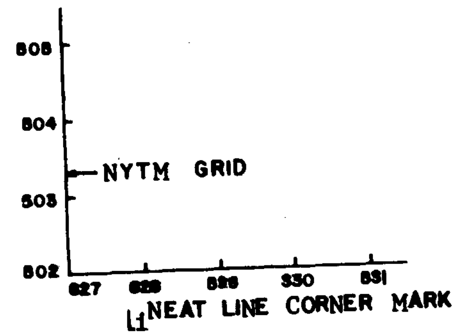


Fig. 2

III. Centroid Numbers:

Each urban area has been inventoried by census tract. Every census tract has been assigned a number by the U.S. Department of Commerce's Bureau of Census. Census tracts contain demographic information. Census tracts are outlined by a heavy black dashed line (·▬▬▬) and the underlined number can be found near the center of the census tract, for example Each census tract is given a unique identifying number or centroid. This centroid number is used for referencing the habitat inventory information. A centroid is used to reference not only individual census tracts but wetlands over 6.2 acres, open space, and Significant Habitats (as designated by the Significant Habitats Unit, D.E.C. Division of

Fish and Wildlife). (A discussion of how the centroid is used for identifying Significant Habitats is made in another part of this guide.) The centroid is indicated on the overlay by a dot. Near the dot two digits can be found in parentheses separated by a comma; example, ((1,2) •). These two digits are used in conjunction with the NYTM grid near the border of the overlay. In the following example (Fig. 3), the unique identifier for the census tract and its centroid is 5038-8292, with the two digits in parentheses forming respectively the last digit on the E-W and the last on the N-S axes. The centroid precisely locates and identifies the census tract.

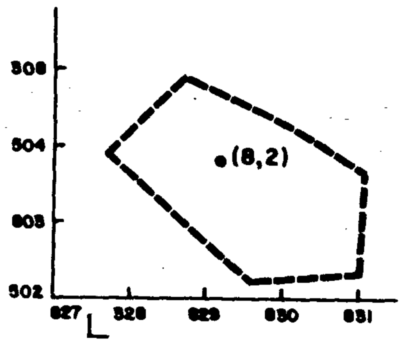
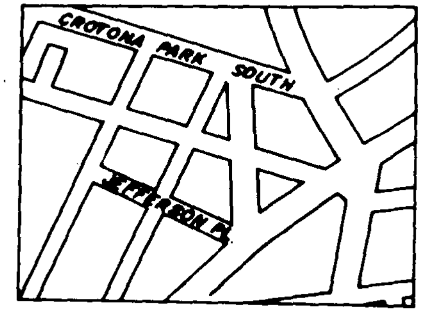


Fig. 3

If a C with an arrow (→) is found on an overlay map it indicates the centroid is located on an adjacent overlay in the direction of the arrow. If a census tract is separated into several segments, the word part follows the census tract number.

The following pictorial outline is offered (Figures 4a-4f) in order to explain how the inventory was undertaken in regard to organization of data.

Fig. 4a



Fie. 4b

Fig. 4c

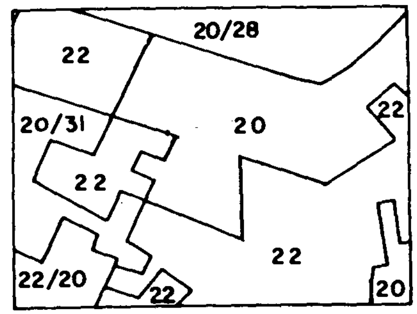


Fig. 4d

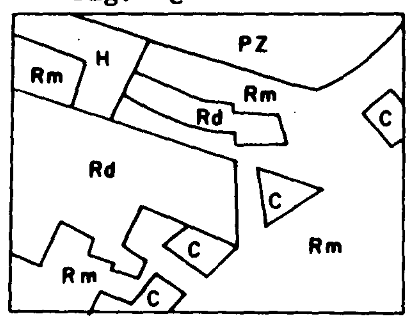


Fig. 4e

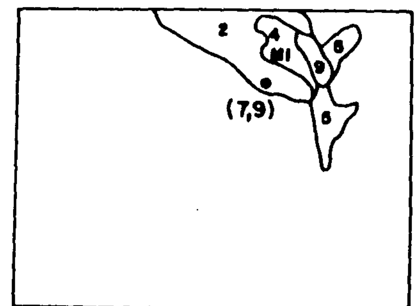


Fig. 4f

IV. Vegetative Covertypes and Land Use Categories:

These two systems comprise the primary components of the Urban Wildlife Habitat Inventory overlay system. Definitions follow:

A. Vegetative Covertypes

The covertype of an area has been determined according to the characteristics of the vegetation and land which surrounds structures within each particular parcel. The smallest area which has been interpreted is approximately an acre in size for upstate areas. Downstate areas (New York City, Westchester Co., and Long Island) were limited by size constraints, i.e., the smallest areas which could be legibly written upon. The guidelines for covertyping are as follows:

a. If covertype "A" constitutes 2/3 or more of a mixture of covertype "A" and covertype "B", the area will be labeled as a pure stand.

b. If covertype "A" constitutes less than 2/3, but more than 1/3 of a mixture of covertype "A" and covertype "B", the area will be labeled as as a mixed stand. The predominant covertype is given first, e.g., "A" mixed with "B" indicates that there is more of covertype "A" than there is of covertype "B". The convention used for labeling mixed covertypes will be slash Inserted between the two covertypes, e.g., "A/B", but only the two major ones are used to classify it. These guidelines are only approximate. The decision on whether or not a covertype was mixed depends ultimately upon the airphoto interpreter's perception of the photograph. (Hardy and Johnston, 1975 and Gardner, 1977).

For the first thirteen covertypes, categories are the same covertypes used in the New York State Wetlands Inventory. For a more complete description of these categories see Schworm 1980. All wetland centroids appear on the overlays (6,5) W; however, some wetlands may not now be present (the wetland may have changed in shape or shifted) or the centroid did not fall within the wetland. If this occurred, both centroid number and the W were enclosed in parenthesis ((6,5) W).

If the wetland centroid fell beyond the area of photo coverage, an arrow was used to show the direction of the centroid point. The centroid number followed the arrow.

Covertype Number 1: Wet Meadow

The vegetation consists of sedges, rushes, coarse grasses, and sometimes cattails. The soil is usually saturated with water. Vegetation tends to grow in clumps or tussocks. Cattails, if present and in low quantities (large quantities would indicate #5) tend to grow between these clumps.

Covertype Number 2: Flooded Live Deciduous Trees

These are live trees that appear to be over 15 feet in height. If not totally flooded, the terrain is hummocky.

Covertype Number 3: Flooded Dead Trees

No distinction is made in this category between deciduous and coniferous trees.

Covertype Number 4: Flooded Shrubs

This covertype is found in a variety of areas including floodplains, frost pockets, edges of ponds, lakes and bogs, and on hillsides. Woody vegetation is classified as shrubs if it has an apparent height of less than 15 feet. Flooded shrubs is the most common wetlands category in New York State.

Covertype Number 5: Emergents

The emergent covertype consists of such plants as cattails, purple loosestrife, bulrushes, reeds, pickerel weed, and arrow-arum. Emergents are often confused with wet meadow. Emergents are generally thought of as herbaceous plants encroaching water areas and flooded with standing water throughout the year.

Covertype Number 6: Drained Muckland

These are areas of intensive agriculture that produce mainly truck crops. Soils are high in organic matter.

Covertype Number 7: Reverted Drained Muckland

Areas of muckland that are no longer farmed and are in the process of reverting back to wetlands vegetation are in this category.

Covertype Number 8: Floating Vegetation

Floating wetlands vegetation may be free floating, such as duckweed, or rooted with floating leaves such as pondweed or water lilies.

Covertype Number 9: Open Water

If open bodies of water and widenings in streams and rivers that are natural or man-made do not have an area in excess of 2.59 hectares, they are covertyped in this category. Open water bodies with an area equal to or greater than 2.59 hectares are not covertyped but are given a gazetteer number from the New York State Gazetteer of Lakes, Ponds and Reservoirs.

Covertype Number 10: Upland Bodies

Dry areas completely surrounded by wetland covertypes are delineated as part of the wetland. Vegetative cover of these areas may vary. Upland bodies (Islands) within Gazetteer Lakes are not delineated.

Note: In some instances, covertype 10 was not used when another covertype was more precise, i.e., 25, 28, 29, etc.

Covertype Number 11: Matted Vegetation

This covertype was eliminated as a covertype, hence it has not been used.

Covertype Number 12: Flooded Conifers

This covertype consists of live coniferous trees (American larch is also included in this category) greater than 15 feet in height. Flooded conifers usually grow in hummocky terrain. The trees tend to grow out of the drier hummocks with pockets of water forming between the hummocks.

Covertype Number 13: Submergents

These are plants that normally grow beneath the surface of the water such as coontail, water milfoil, and bladderwort. At times completely flooded non-robust emergents (arrow-arum, smartweed, pickerel weed) appear to be submergents and may be interpreted as such.

Covertype Number 14: Mudflats

Mudflats is a non-vegetated covertype added in the course of interpreting the Catskill Region and the Hudson River. For the purposes of the Urban Wildlife Habitat Inventory, dredge spoil sites were also covertyped as mudflats.

N.B. ONLY THOSE WETLANDS FROM WETLAND INVENTORY MAPS (COVERTYPES 1-14) WITHIN A CENSUS TRACT AND 2.5 HECTARES (6.2 ACRES) AND LARGER IN SIZE HAVE A CENTROID NUMBER PLACED ON THE OVERLAY. (Figure 5 gives an example of a wetland centroid)

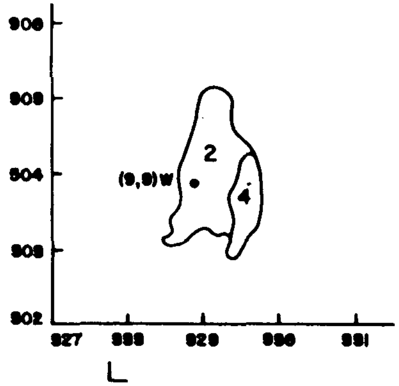


Fig. 5

Covertype Number 15: Streams and Creeks

Any natural body of water small in size flowing in a definite course 200' or less in width. These areas were labeled on the map overlay when the space provided for labeling was wide enough. In most instances the creek or stream appears on the base map.

Covertype Number 16: River

A natural stream of water of fairly large size flowing in a definite course or channel or series of diverging and converging channels more than 200' in width. Rivers can be found on U.S.G.S. topo maps and DOT planimetric maps, along with creeks and streams. These base maps were used to determine the mapping status for either covertype 15 or 16.

Covertype Number 17: Tidal

A water regime which is influenced by tides. These wetlands may be fresh, brackish or saline. No distinction is made between the different types of tidal wetlands; for example, high marsh, littoral zone, coastal shoals. Coastal fresh marsh and channels within the tidal area were excluded from covertype 17, as was intertidal marsh. More information on tidal wetlands is available from the Tidal Wetlands Inventory at the Region 1 Department of Environmental Conservation Offices, Building 40, Stony Brook, New York 11790.

Covertype Number 18: Rock

Areas of bare rocks or rocks slightly covered with vegetation.

Covertype Number 19: Sandy areas

Bare sand or sand slightly covered with vegetation. Beaches are included in this category.

Covertype Number 20: Lawn

Areas which are largely in lawns or sod in addition to being planted for gardens or landscaping. Lawns can be extensive in size, i.e., golf course greens and fairways, park playing fields, highway right of ways.

Covertype Number 21: Pastures

Permanent or unrotated pasture areas for livestock purposes.

Covertype Number 22: Surfaced

An area which is covered with crushed rock, gravel, paved, packed soil, oil soaked soil and supports no vegetation.

Covertype Number 23: Cultivated

Areas used for growing cultivated vegetables and field crops (including hay) nurseries and sod and seed farms.

Covertype Number 24: Disturbed

An area which is undergoing or has undergone change due to construction of land use practices which has markedly altered the existing vegetation to the extent where vegetation is sparse or no longer present. The land character can be made up of eroded soil and spoils from construction/renewal projects.

Covertype Number 25: Old field

Old meadows or abandoned fields which are gradually seeding into weeds and/or shrubs and trees. Vegetation is present on these areas.

Covertype Number 26: Orchards

Active commercial orchards.

Covertype Number 27: Brush

Woody vegetation (including conifers)which does not exceed 15-20 feet in height, may Include to some degree stands to 30 feet in height.

Covertype Number 28: Deciduous trees

Land supporting primarily hardwood species over 30 feet in height. Depending on the date of photography, larch could be included in this category.

Covertype Number 29: Coniferous trees

Land supporting primarily softwood species over 30 feet in height; will also include softwood plantations.

Covertype Number 30: Burned areas

Areas recently burned.

Covertype Number 31: Shrubs and Trees

A typical vegetative covertype in urban and suburban areas. It is usually a collection of deciduous and coniferous trees and shrubs (both native and introduced) in association with lawns which surround buildings. In most residential urban areas, houses have "green areas" around the house. These are usually composed of both the front and back yards. If the crown cover of trees and/or shrubs extends over most of the yards (2/3 cover) this covertype will be given. This covertype was established to differentiate between "natural" stands of trees and shrubs (categories Nos. 27-28-29) which may be found within and near cities. This is not to imply that a residential area and a natural stand of trees and shrubs are mutually exclusive to each other.

B. Land Use

Land use for a particular area was determined from the airphotos by observing the apparent land use. The standards used in setting up land use categories were developed from the pilot inventory and after L.L. Pounall, 1950. In some Instances, combinations of land use were used (i.e., C/Rm,H/C); the same criteria for establishing mixed covertypes was used for establishing mixed land use.

Land Use Symbol A: Agriculture

Area used for production of vegetables, small fruits, truck farm and field crops. Areas for livestock production, also riding rings, are also included in this definition. Greenhouses are included in this type land use when found in conjunction with active agriculture. However, if no large area of open farm land was adjoining the area the site was deemed commercial.

Land Use Symbol B: Campgrounds

Both public and private organizational camps for tents or permanent cabins and outdoor recreational vehicles. Most areas are located on the outskirts of cities and are listed on either topographic or planimetric maps.

Land Use Symbol C: Commercial Areas

An area of buildings and parking lots predominantly utilized in the sale of products, and office building, hotels, motels and shopping centers. Greenhouses which serve as a retail outlet will be listed as commercial. Commercial horse farms will be listed as C; however fields, pastures and riding rings will be listed as A.

Land Use Symbol D: Waate Disposal, Dumps

Solid waste material discarded in an open pile.

Land Use Symbol Dj: Waste Disposal, Junk Yard

Areas which deal with automotive replacement parts (junked cars) and scrap metals.

Land Use Symbol Dl: Waste Disposal, Landfill

A disposal area in which wastes are regularly covered with soil. This designation was used for dredge material near bodies of water. Clean fill for construction and reclamation are also included in this category.

Land Use Symbol Ds: Waste Disposal Sewage Treatment Plant

Areas used to treat municipal waste. Some large corporations may have their own sewage treatment plants.

Land Use Symbol E: Extractive Excavation

All mining operations within the following categories: gravel pits, stone quarries and sand pits. In some instances, an old stone quarry may be filled with water, therefore E 9 (Extractive excavation open water)

Land Use Symbol F: Forests

Includes natural stands of maturing forests and plantations. Minimum size, 10 hectares. Some land uses such as parks, golf courses and institutions often overrode the designation of Forest as a land use because they are more specific. Also, if land use H, P, G, with the appropriate covertypes (28, 29) affected a small parcel of V land, the land use would be changed to F. Both pure and mixed stands of trees and shrubs with trees being dominant. The 10 ha. minimum size can include several different vegetative types or land use totaled together, e.g.,

5 ha. covertype 28
7 ha. covertype 28/27
12 ha. = Forest land use

Land Use Symbol G: Golf Course

Includes both public and private facilities (including club house and parking lot). Golf driving ranges may also be Included but if separated from a golf course, they will be labeled "C" commercial

Land Use Symbol H: Institutional

Prisons, hospitals, clinics, municipal offices, maintenance centers, military installations, and schools are included in this category. For the New York City area, city, county, state, municipal and private agencies may be included from planning maps.

Land Use Symbol Ih: Industry (heavy)

Industries which work with such raw materials as iron ore, lumber, coal and petroleum. Also Includes "tank farms" (storage) mainly present along waterways and port facilities.

Land Use Symbol Il: Industry (light)

Industry which is devoted to product manufacturing. No obvious raw material observed. Warehouses are considered in this land use.

Land Use Symbol J: Cemetery

Both public and private.

Land Use Symbol K: Canal

A navigable channel improved for use by boats and barges. Man made draining patterns (e.g., mosquito ditch) were ignored. On Long Island channelized streams were ignored.

Land Use Symbol L: Construction

Area of land undergoing building construction site preparation, road construction.

Land Use Symbol M: Marina

Boat launching sites plus dry docks for pleasure boats, yacht clubs. Private docks are not included on the overlay. Water areas were usually not Included.

Land Use Symbol N: Airports

Includes all types of facilities - commercial, noncommercial and military.

Land Use Symbol O: Race Tracks

All types race tracks - automotive and horse. All tracks except those in conjunction with a breeding or training operation.

Land Use Symbol P: Parks

Includes amusement parks, fairgrounds, developed beaches and city, town, county and state parks.

Land Use Symbol Qa: Railroads (active)

Used for train traffic;also Includes tractor trailer loading area and station parking lots.

Land Use Symbol Qi: Railroads (inactive)

Tracks abandoned, no current rail use. Usually the rail bed is present but the ties and rails have been removed.

Land Use Symbol Rd: Residential Development

Five or more houses per 1000 feet of frontage. In cities, two family houses are often included in this category if the area is heavily urbanized.

Land Use Symbol Rm: Residential Multiple Units

Includes apartment houses and in some instances, hotels and motels, which are hard to distinguish from apartment buildings. Usually three or more stories per structure. Trailer parks were also considered in this category.

Land Use Symbol Rs: Residential Single Houses

Less than five houses per 1000 feet of frontage; two-family houses may be included.

Land Use Symbol S: Water Engineered Featured

This land use was comprised of bulkheads, dams, dikes, ditches, channels, constructed ponds and water recharge basins (i.e., sumps). Water towers were considered to be structural features and labeled H.

Land Use Symbol V: Vacant Land

This category is used when no apparent use of the land can be stated by any of the proceeding descriptions. Highway and adjacent land included here. Usually used for water and wetland areas but when covertype 2 (flooded live deciduous trees) or 12 (flooded conifers) was dominant and comprising 10 ha. alone or in combination the land use was usually F.

Land Use Symbol Z: Open Space

A large tract of vegetated land 20 hectares inclusive. The area may serve as a corridor connecting urban and suburban areas with larger tracts of wildlife habitat. These corridors may aid in the dispersal of wildlife species into urban and suburban habitat, and may serve as stopover areas for birds during migration. For example, these areas may include the following types of land use when appropriate: agricultural, forests, airports, golf courses, campgrounds, institutional, cemeteries, parks, railroads (inactive) and vacant land. These areas can be in all of the vegetative covertypes, except for surfaced, open water, streams, rivers. In some instances, disturbed areas were not considered to be a Z area depending on the API's assessment. However, many major highways, in particular parkways have extensive tracts of vegetation along their borders; because of this, these highways are classified as Z areas. The roadway itself is ignored. Mapped with other symbols, e.g., FZ = Forest open space. All open space areas have been given a centroid number for referencing purposes, e.g., (4,5)Z. The Z follows the parenthesis so it can't be confused with any other type of centroid.

Note: There is only 1 centroid for an entire Z area. Even those areas of several hundred or thousand hectares have only 1 centroid. Because of this, one overlay may have an extensive Z area but no centroid; the centroid can usually be found on an adjoining overlay. In some cases (Long Island and Westchester Co.), these same Z areas may be found on <u>many</u> different overlays.

V. Significant Habitats:

The Significant Habitat Unit of the Bureau of Wildlife has declared certain areas within the State as significant for wildlife and fish. These areas have been designated on the inventory maps by a centroid followed or preceded by a symbol. A key for the symbols is as follows:

◩ Significant for wildlife
□ Significant for plants
■ Significant for wildlife and plants
◉ Potentially significant for wildlife
○ Potentially significant for plants
● Potentially significant for wildlife and plants
▲ Known deer concentration areas
△ Known deer concentration areas not in use
▲ Aerial survey yards - not field checked
✡ Other - such as unique geological formations

VI. Literature Cited

1. Gardner, C., 1977. Wetland covertype description and clues for the air photo interpretation of wetlands on 1:24,000 panchromatic photography. N.Y.S. Dept. of Environ. Cons. 9 p. (mimeo).

2. Hardy, E.E. and C.A. Johnston, 1975. New York State wetlands inventory: technical report N.Y.S. College of Ag. and Sci., Cornell Univ., Ithaca, N.Y. 144 p.

3. Pounall, L.L., 1950. Photo interpretation of urban land use. Photogramm. Eng. 16(3): 414-426.

4. Schworm, P.A., 1980. Freshwater wetlands overlay use guide. N.Y.S. Dept. of Environ. Cons. 11 p. (mimeo).

VII. Additional Information:

If you would like additional information on the Urban Wildlife Habitat Inventory, please contact one of the following units:

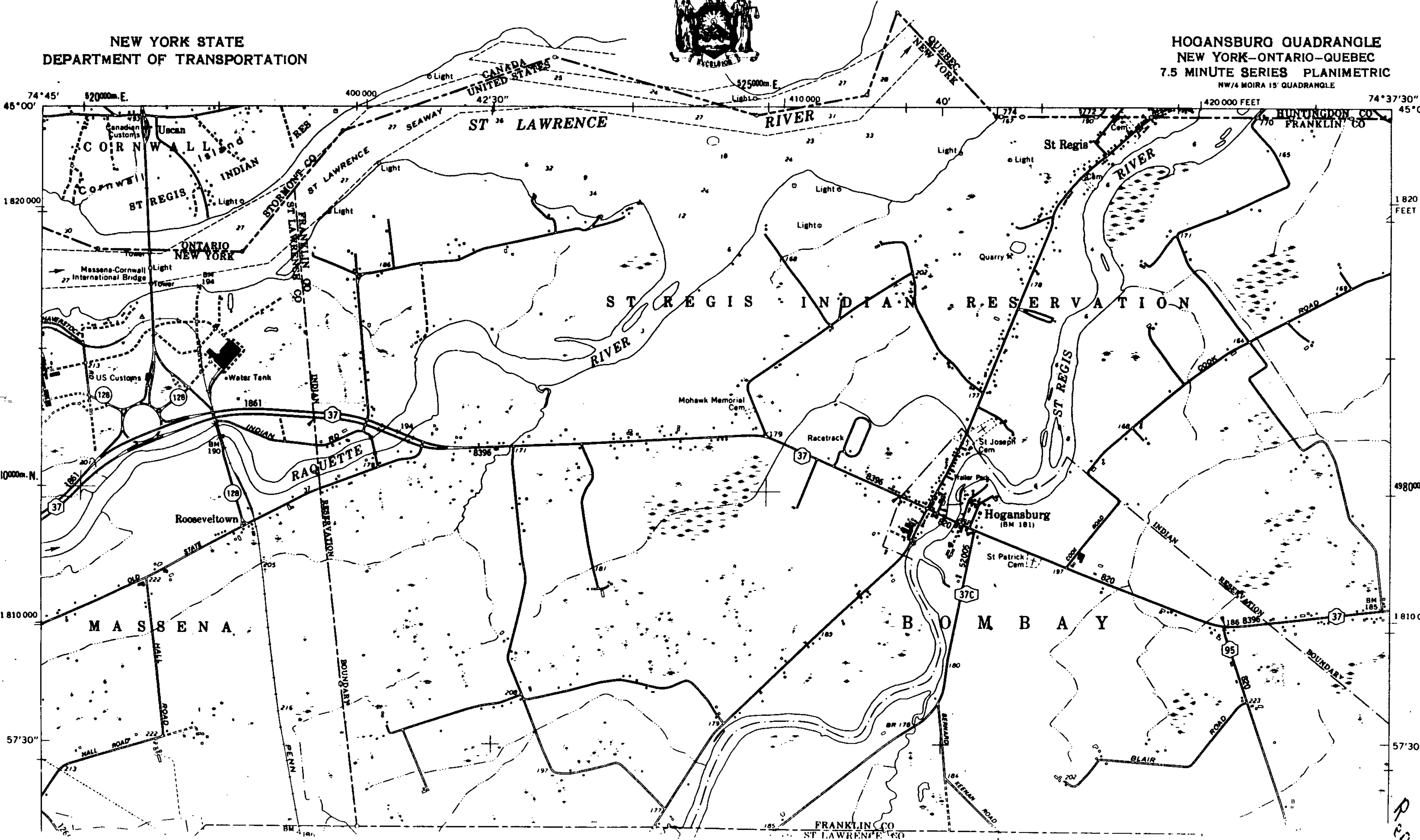
Habitat Inventory Unit
50 Wolf Road
Albany, NY 12233
(518)457-3431

Urban Wildlife Environments Program
Wildlife Resources Center
Delmar, NY 12054
(518)457-5782

M. J. Matthews
June 1981

NEW YORK STATE
DEPARTMENT OF TRANSPORTATION

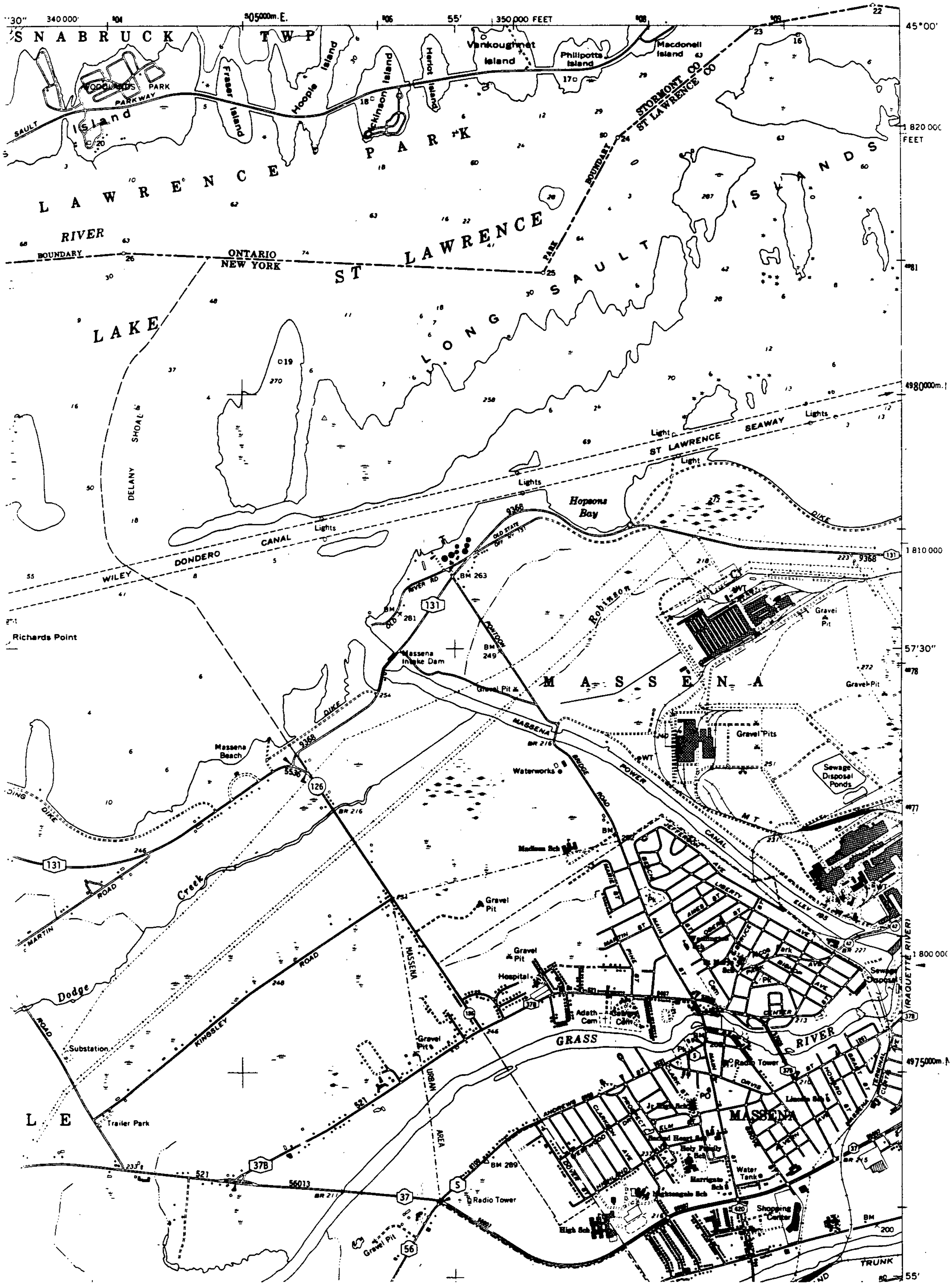
HOGANSBURG QUADRANGLE
NEW YORK–ONTARIO–QUEBEC
7.5 MINUTE SERIES PLANIMETRIC
NW/4 MOIRA 15' QUADRANGLE

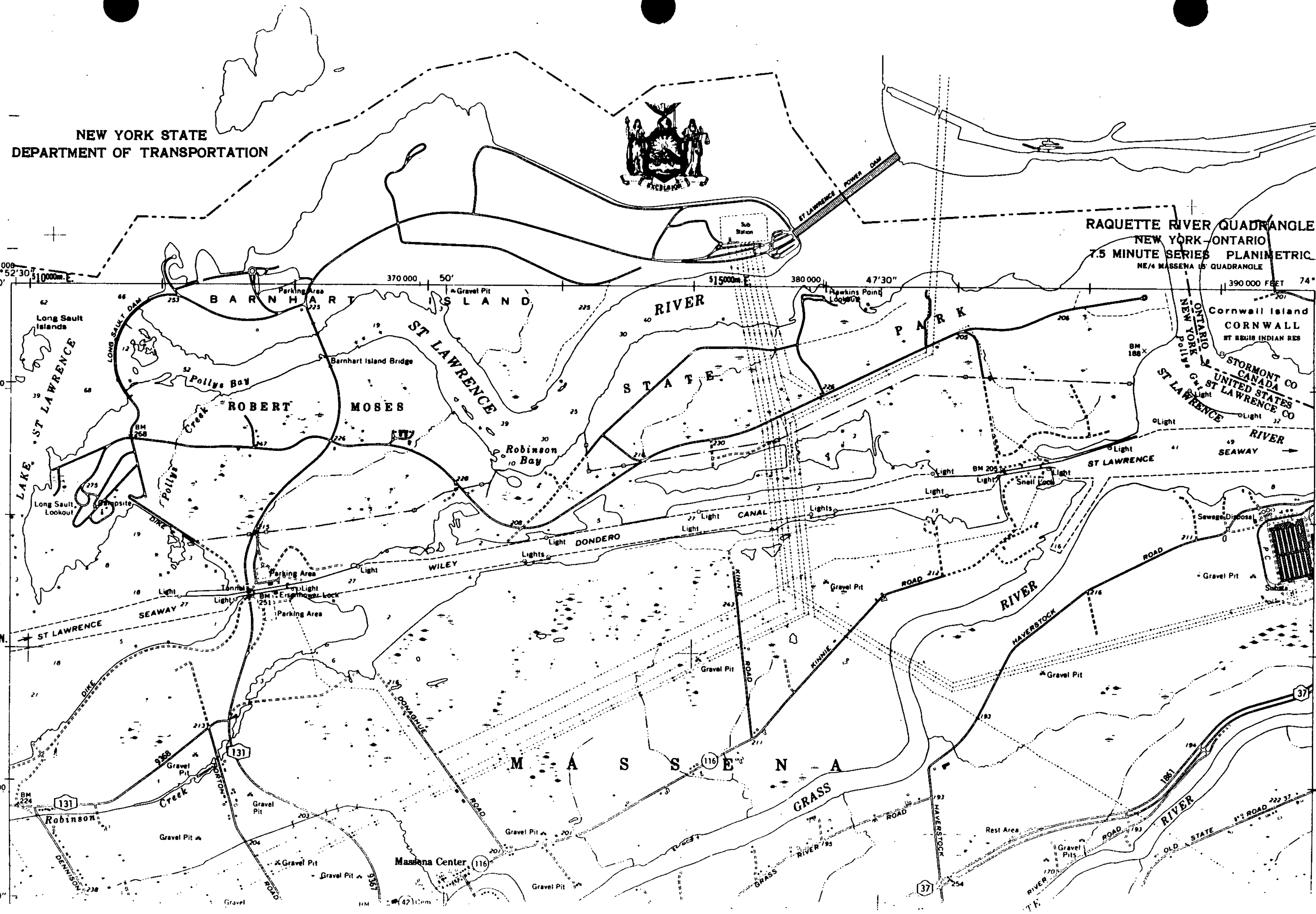


Reference 8.1

Reference 9.1

MASSENA QUADRANGLE
NEW YORK–ONTARIO
7.5 MINUTE SERIES PLANIMETRIC
NW/4 MASSENA 15' QUADRANGLE




NEW YORK STATE
DEPARTMENT OF TRANSPORTATION
RAQUETTE RIVER QUADRANGLE
NEW YORK-ONTARIO
7.5 MINUTE SERIES PLANIMETRIC
NE/4 MASSENA 15' QUADRANGLE
ST LAWRENCE POWER DAM
Sub Station
BARNHART ISLAND
ST LAWRENCE RIVER
ROBERT MOSES STATE PARK
Barnhart Island Bridge
Long Sault Islands
LONG SAULT DAM
Pollys Bay
Pollys Creek
LAKE ST LAWRENCE
Long Sault Lookout
Campsite
Robinson Bay
Hawkins Point Lookout
Cornwall Island
CORNWALL
ST REGIS INDIAN RES
STORMONT CO
CANADA
UNITED STATES
ST LAWRENCE CO
ONTARIO
NEW YORK
ST LAWRENCE SEAWAY
WILEY DONDERO CANAL
Eisenhower Lock
Snell Lock
Tunnel
Parking Area
Sewage Disposal
Substa
DIKE
KINNIE ROAD
HAVERSTOCK ROAD
DONAGHUE ROAD
ROBINSON
DENNISON ROAD
GRASS RIVER
RIVER ROAD
OLD STATE ROAD
Rest Area
Gravel Pit
Massena Center
MASSENA
131
116
37

10.1

NEW YORK STATE PCB SAMPLING
GRASSE & ST. LAWRENCE RIVERS/VICINITY
MASSENA, NEW YORK

Reference

11.1

Limited sampling for PCBs in fish and sediments was done in 1980 in the Massena area. This sampling is an extension of the routine water quality monitoring for toxic substances. A summary of the sample locations and results are shown below. The sample locations are shown on the attached map of the Massena area.

Sediment Samples
µg/g (ppm) Aroclor

Sample Site	1221	1016/1242	1254	1260	Mirex
Grasse River Upstream Site 9	.004	<.002	.007	<.002	<.002
Alcoa Launch Site Site 5	<2.0	49.0	8.7	<2.0	<2.0
Robinson Creek Bay Site 8	<.002	.003	.004	<.002	<.002
St. Lawrence Site 4	<.002	.01	.002	<.002	<.002
Power Canal Discharge Site 6	<.002	.04	.04	<.002	<.002
Grasse River Mouth Site 3	<.002	1.6	0.45	<.002	<.002

PCB Fish Analysis - July 21-25, 1980
Fish Flesh Samples

Location	Species	No. Fish	Avg. Total PCB	Min. PCB	Max. PCB
Grasse R. abv. Massena Station 1	Sm. Mouth Bass	2	1.25	1.19	1.50
	White Sucker	1	0.12	0.12	0.12
	Pumpkinseed	6	.09	.05	.14
St. Law. River above Massena Station 2	Rock Bass	4	.18	.10	.24
	Fall Fish	4	.25	.08	.52
Bobinson Creek Station 3	Bullhead	4	.58	.47	2.15
	N. Pike	1	0.14	0.14	0.14
	Golden Shiner	3	.26	.17	.57

St. Law. River below Power Dam/Station 4	Pumpkinseed	2	.22	.17	.26
	Sm. Mouth Bass	2	.08	.06	.10
	Black Crappie	1	.52	.52	.52
Grasse River below Massena STP/Station 5	Br. Bullhead	1	1.48	1.48	1.48
	Sm. Mouth Bass	2	1.54	1.00	2.08
	Fall Fish	2	5.45	5.52	5.59
	Rock Bass	5	1.08	.26	2.44
St. Law. R. Reynolds Aluminum outfall/St.6	Fall Fish	1	2.55	2.55	2.55
	N. Pike	1	7.10	7.10	7.10
	Rock Bass	6	2.45	1.60	5.82
Mouth Grasse River/Station 7	Rock Bass	4	.65	.48	.99
	Br. Bullhead	4	1.22	0.26	2.74

The fish samples were either filleted or analyzed whole minus head and viscera depending upon size.

There is no one standard which may be used to evaluate the significance of the PCB levels measured. The U.S. Food and Drug Administration has set a maximum level of 5 ppm PCB for sale of commercial fish. There has been no maximum allowable level for PCB in sediments established but 50 ppm has been used as a guideline in the upper Hudson River to determine if sediment removal is warranted.

The Massena area has three major industrial plants: ALCOA, Reynolds and General Motors Central Foundry. The ALCOA discharge is to the Grasse River approximately 10,000 meters upstream from its confluence with the St. Lawrence River. The Reynolds and General Motors Central Foundry discharges directly into the St. Lawrence approximately 1,500 and 5,000 meters respectively downstream of the Grasse River confluence.

Each plant has recognized their possible PCB problems and is implementing programs to eliminate any potential for further significant PCB discharges to the environment. A brief description of the plants and their steps to minimize PCB discharges from their treatment systems follow:

ALUMINUM COMPANY OF AMERICA

The Massena ALCOA facility is an integrated aluminum plant including reduction, casting and manufacture of ingot, wire rod and bar products.

The mill site has been in use since about 1903 and is one of the oldest reduction plants in the country. It has been modified and expanded many times since its initial construction and is currently a modern facility.

Until the early 1960's the wastewater treatment system was the typical direct discharge. The company started upgrading their wastewater treatment system in the early 1960's and is a continuing project. The system currently consists of a series of lagoons for waste stabilization including a sanitary waste lagoon, a primary lagoon for water from the carbon bake furnace air scrubbers and a 65-acre ~~sanitary~~ Secondary lagoon for treating the total plant wastewaters.

All major non sanitary waste flows have now been directed to the secondary lagoon and receive treatment prior to discharging to the Grasse River. A total of 18 mgd average is treated in the secondary lagoon.

The company also has a holding lagoon for spent caustic solutions and soluable oil which is not connected to the treatment system. Until recently it also had a used lube oil lagoon. The lube oil lagoon has now been emptied and filled.

A 1980, 72-hour sampling of the ALCOA secondary lagoon outfall showed low concentrations of PCB's present measuring between 2.7 and 4.3 ppb. A 24-hour sampling in February 1981 showed a reduction to 1.2 ppb. The company has undertaken an intensive PCB trackdown program and has tentatively identified a small number of continuing sources of PCB's to the waste stream. The company is pursuing more positive identification of the contaminated sources and their elimination is expected soon. A PCB limit of 1 ppb average and 2 ppb maximum is proposed for the ALCOA wastewater discharge permit for the main outfall to the Grasse River.

REYNOLDS METALS COMPANY

Reynolds Metals operates an aluminum reduction plant utilizing the soda-burg process. The plant water intake is from the St. Lawrence River, downstream of the confluence with the Grasse River. The company has a wastewater discharge permit (#NY 0000540) to discharge 4 MGD process water; 2 mgd non contact water; and 0.375 mgd sanitary sewage to the St. Lawrence River through three separate outfalls.

Sampling for PCB's done by the company using a sensitivity of 0.01 ppb has not detected PCB's in either the intake or discharge water. Sampling of the process water discharge done by New York State DEC in September 1980, likewise, identified no detectable levels of PCB's using a sensitivity of 0.05 ppb with the exception of one suspect result of 0.5 ppb for Aroclor 1016/1254. The current wastewater discharge permit has a maximum allowable level of total PCB discharge of 1 ppb daily average and 2 ppb daily maximum. The permit also requires that the company run a short time high intensity PCB monitoring study for the old process water outfall by July 15, 1981.

GENERAL MOTORS/CENTRAL FOUNDRY

The General Motors/Central Foundry Division is primarily a cast shop making cast aluminum automotive products. Until the early 1970's some die casting machines used a hydraulic oil with a PCB base. Although purchase of PCB oils was discontinued in 1973 and the hydraulic systems flushed, the current hydraulic systems may still have a low residual PCB contamination level. The intake water for the plant is taken from the St. Lawrence River and has been analyzed to contain detectable but low PCB levels averaging .34 ppb for samples taken between January 1978 and March 1979. The water intake is located downstream of the confluence of the Grasse River and the analyses are possibly more representative of the levels from the Grasse River than from the mainstream St. Lawrence.

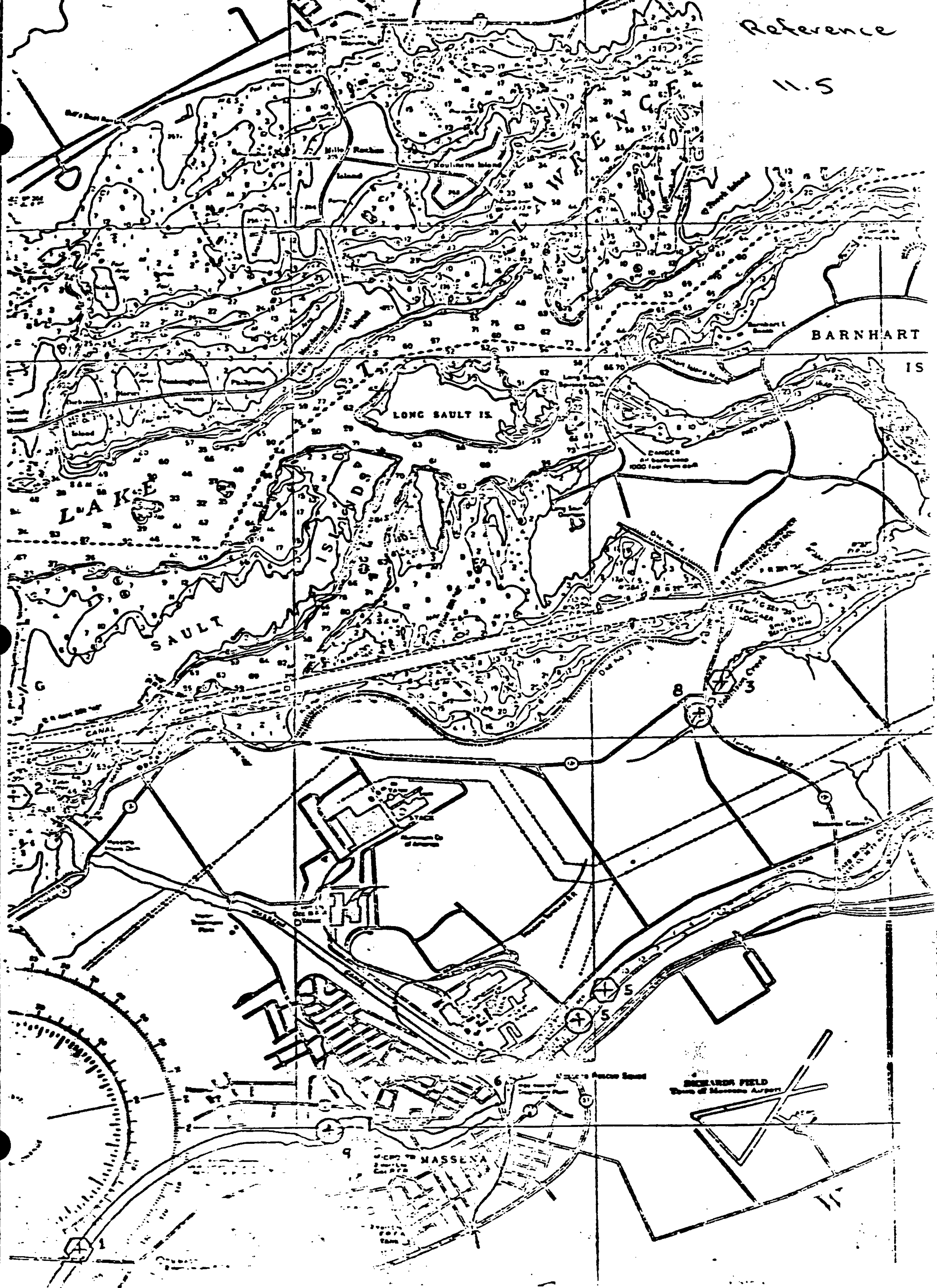
The process and cooling water from General Motors is a closed loop system with an intermittent discharge. The measured levels in the discharge water average 4.5 ppb for tests taken between January 1978 and March 1979.

The water discharge permit, #NY 0000540, issued to the company required that they do additional sampling of their waste treatment lagoon used until 1980. Samples of this lagoon taken in the spring of 1980 for PCB analysis indicated some residual PCB contamination at the lagoon. The company has discontinued the use of the old waste treatment plant and has constructed a new treatment system which is designed to meet all current wastewater discharge permit levels including PCB's. This permit allows no more than 1 ppb daily average PCB's or 2 ppb maximum concentration at any time.

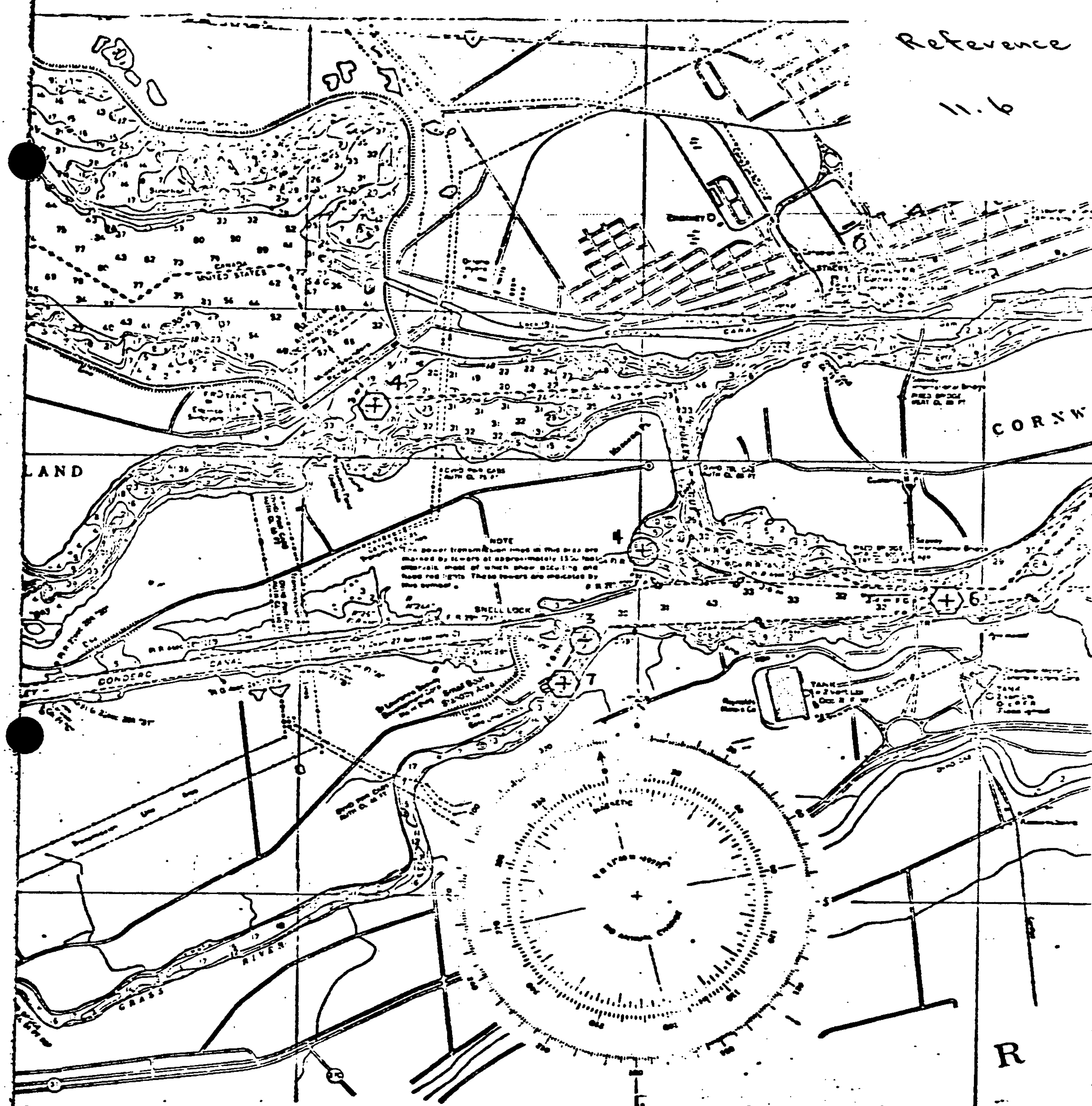
General Motors has also instituted an extensive groundwater monitoring program in the vicinity of their landfill and PCB contaminated sludge pits and has found a detectable PCB level in the groundwater. The company is in the process of controlling the suspected sources of PCB's to prevent further groundwater contamination. The effect of this groundwater contamination on surface waters is unknown but is believed to be insignificant.

Reference

11.5



Reference 11.6



1980 NYS DEC SAMPLING STATIONS

SEDIMENT

FEET
YARDS
METERS

11.7

Dr. Robert Collins, Water Research
Darrell Sweredoski, Region 6
Grasse River PCB Trackdown Program - St. Lawrence County

July 11, 1980

On June 5, 1980 as part of the subject project, we gathered samples from the Grasse River, Power Canal, and St. Lawrence River in nine (9) locations as follows:

Sample #1 - Dredge sample from the ALCOA weir. The sediment was 6-12" deep and consisted of coarse to fine sand and silt with a rocky bottom. The sample was taken from a back eddy created by the ALCOA discharge and approximately in the same area as sampled in 1979.

Sample #2 - Dredge sample from the ALCOA boat launch site, downstream from ALCOA discharge. Fine sand to silt type deposit in 13' of water. Sediment was over 2' deep and located in an area with a slight back current.

Sample #3 - Core from the mouth of the Grasse River in about 5' of water along the north shore. Deep sandy to silt and clay sediment was encountered. A 14" core was extracted.

Sample #4 - Dredge sample from Polly's Gut in the St. Lawrence River. Silty to clay sediment was found in 8' of water. Much macro invertebrate life was observed in sample. Sample was collected from an eddy along the west shore.

Sample #5 - Core at the ALCOA launch site about 75' upstream from the launch site but downstream from the ALCOA discharge weir. Water depth was 4-5' and a sandy silty deposit was collected. A 12" core was collected.

Sample #6 - Dredge sasple from the discharge end of the Power Canal. A mucky type sediment was collected in deep water of unknown depth (20-30').

Sample #7 - Dredge sample from the downstream end of the Power Canal.intake structure. Water depth estimated at 35'. A black, mucky sediment was collected.

Note: the water in the Power Canal is practically stagnet with a very low flow discharging into the Grasse River upstream from the ALCOA discharge.

Sample #8 - Robinson Creek Bay in 1' of water on the west side of Route 131 and along the north shore. A shallow sandy silty sediment was collected.

Sample #9 - Dredge sample from Grasse River in back of the Massena fire hall. This area is upstream from all industrial or municipal discharges into the Grasse River in the Massena area. The sample was collected from the north shore in about 2' of water in an eddy current. The sediment was a sandy silty deposit.

Samples 3, 4, 5, 6, 8, and 9 were submitted for PCB analysis. A 6" middle section from core 3 was submitted and the entire core 5 submitted.

An oil sheen was noted when core 5 was brought to the surface. I also detected an oil odor from core 5.

Darrell Sweredoski
Sanitary Engineer
Region 6

DMS:ks

11.9

317 Washington Street
Watertown, New York 13601
315-782-0100, Ext. 251

October 9, 1980

Mr. Phil Woodward
ALCOA
Box 150
Massena, New York 13662

Dear Mr. Woodward:

Enclosed are copies of our test results for sediment samples taken from the Grasse River during the summer of this year.

If I can be of further assistance, please do not hesitate to call me.

Sincerely,

Darrell Sweredoski
Sanitary Engineer
Region 6

DS:ms
Encloeures

11.10

0066

NEW YORK STATE DEPARTMENT OF HEALTH
DIVISION OF LABO4ATORICS AND RESEARCH
ENVIRONMENTAL HEALTH CENTER

RESULTS OF EXAMINATION
(PAGE 1 OF 1)

LAB ACCESSION NO: 80867 YR/MO/DAY/HR SAMPLE REC'D: 80/06/19/16

REPORTING LAB: 17 EHC ALBANY
PROGRAM: 650 SOLID WASTES
STATION (SOURCE) NO:
DRAINAGE BASIN: 09 NY GAZETTEER NO: 4402 COUNTY: ST. LAWRENCE
COORDINATES: DEG ' "N, DEG ' "W
COMMON NAME INCL SUBW'SHED: CRASSE RIVER TRIB TO ST LAWRENCE RIVER T. MASSENA
EXACT SAMPLING POINT: GRASSE RIVEER UPSTREAM
TYPE OF SAMPLE: 61 NAT. OR POLL. SEDIMENT
MO/DAY/HR OF SAMPLING: FROM 00/00 TO 06/05/12
REPORT SENT TO: CO (1) RO (1) LPHE (0) LHO (0) FED (0) CHEM (1)

	PARAMETER	UNIT	RESULT	NOTATION
038003	P.C.B., AROCLOR 1016/1242	MCG/G	0.002	LT
038103	P.C.B., AROCLOR 1254	MCG/G	0.007	
039803	P.C.B., AROCLOR 1221	MCG/G	0.004	
039903	MIREX	MCG/G	0.002	LT
041603	P.C.B., AROCLOR 1260	MCG/G	0.002	LT

Sample #9

DATE COMPLETED: 9/17/80

NYS DEPT. OF ENVIRONMENTAL CONSERVATION
WATERTOWN STATE OFFICE BDG
317 WASHINGTON STREET
WATERTOWN, N.Y. 13601

SUBMITTED BY: SWERDOSKI

0072

NEW YORK STATE DEPARTMENT OF HEALTH
DIVISION OF LABORATORIES AND RESEARCH
ENVIRONMENTAL HEALTH CENTER

RESULTS OF EXAMINATION
(PAGE 1 OF 1)

LAB ACCESSION NO: 80868 YR/MO/DAY/HR SAMPLE REC'D: 80/06/19/16

REPORTING LAB: 17 EHC ALBANY
PROGRAM: 650 SOLID WASTES
STATION (SOURCE) NO:
DRAINAGE BASIN: 09 NY GAZETTEER NO: 4402 COUNTY: ST. LAWRENCE
COORDINATES: DEG ' "N. DEG ' "W
COMMON NAME INCL SUBW'SHED: GRASSE RIVER MASSENA

EXACT SAMPLING POINT: ALCOA LAUNCH SITE CORE
TYPE OF SAMPLE: 61 NAT. OR POLL. SEDIMENT
MO/DAY/HR OF SAMPLING: FROM 00/00 TO 06/05/12
REPORT SENT TO: CO (1) RO (1) LPHE (0) LHO (0) FED (0) CHEM (1)

	PARAMETER	UNIT	RESULT	NOTATION
038003	P.C.B., AROCLOR 1016/1242	MCG/G	49.	
038103	P.C.B., AROCLOR 1254	MCG/G	8.7	
039803	P.C.B., AROCLOR 1221	MCG/G	2.0	LT
[illegible]903	MIREX	MCG/G	2.0	LT
041603	P.C.B., AROCLOR 1260	MCG/G	2.0	LT

Sample #5

DATE COMPLETED: 9/17/80

NYS DEPT. OF ENVIRONMENTAL CONSERVATION
WATERTOWN STATE OFFICE BDG
517 WASHINGTON STREET
WATERTOWN, N.Y. 13601

SUBMITTED BY: SWERDOSKI

0076 NEW YORK STATE DEPARTMENT OF HEALTH

11.12

DIVISION OF LABORATORIES AND RESEARCH
ENVIRONMENTAL HEALTH CENTER

RESULTS OF EXAMINATION
(PAGE 1 OF 1)

LAB ACCESSION NO: 80869 YR/MO/DAY/HR SAMPLE REC'D: 80/06/19/16

REPORTING LAB: 17 EHC ALBANY
PROGRAM: 650 SOLID WASTES
STATION (SOURCE) NO:
DRAINAGE BASIN: 09 NY GAZETTEER NO: 4402 COUNTY: ST. LAWRENCE
COORDINATES: DEG ' "N, DEG ' "W
COMMON NAME INCL SUBW'SHED: ROBINSON CREEK TRIB TO ST LAWRENCE MASSENA

EXACT SAMPLING POINT: ROBINSON CREEK BAY
TYPE OF SAMPLE: 61 NAT. OR POLL. SEDIMENT
MO/DAY/HR OF SAMPLING: FROM 00/00 TO 06/05/12
REPORT SENT TO: CO (1) RO (1) LPHE (0) LHO (0) FED (0) CHEM (1)

	PARAMETER	UNIT	RESULT	NOTATION
036003	P.C.B., AROCLOR 1016/1242	MCG/G	0.003	
038103	P.C.B., AROCLOR 1254	MCG/G	0.004	
039803	P.C.B., AROCLOR 1221	MCG/G	0.002	LT
[illegible]9903	MIREX	MCG/G	0.002	LT
041603	P.C.B., AROCLOR 1260	MCG/G	0.002	LT

Sample #8

DATE COMPLETED: 9/17/80

NYS DEPT. OF ENVIRONMENTAL CONSERVATION
WATERTOWN STATE OFFICE BDG
317 WASHINGTON STREET
WATERTOWN, N.Y. 13601

SUBMITTED BY: SWERDOSKI

11.13

NEW YORK STATE DEPARTMENT OF HEALTH
DIVISION OF LABORATORIES AND RESEARCH
ENVIRONMENTAL HEALTH CENTER

RESULTS OF EXAMINATION
(PAGE 1 OF 1)

ACCESSION NO: 80870 YR/MO/DAY/HR SAMPLE REC'D: 80/06/19/16

ORTING LAB: 17 EHC ALBANY
GRAM: 650 SOLID WASTES
TION (SOURCE) NO:
NAGE BASIN: 09 NY GAZETTEER NO: 4469 COUNTY: ST. LAWRENCE
DINATES: DEG ' "N. DEG ' "W
ON NAME INCL SUBW'SHED: ST LAWRENCE MASSENA

T SAMPLING POINT: POLLYS CUT
OF SAMPLE: 61 NAT. OR POLL. SEDIMENT
AY/HR OF SAMPLING: FROM 00/00 TO 06/05/12
RT SENT TO: CO (1) RO (1) LPHE (0) LHO (0) FED (0) CHEM (1)

	PARAMETER	UNIT	RESULT	NOTATION
03	P.C.B.. AROCLOR 1016/1242	MCG/G	0.01	
03	P.C.B.. AROCLOR 1254	MCG/G	0.002	
03	P.C.B.. AROCLOR 1221	MCG/G	0.002	LT
03	MIREX	MCG/G	0.002	LT
03	P.C.B.,AROCLOR 1260	MCG/G	0.002	LT

Sample #4

COMPLETED: 9/17/80

NYS DEPT. OF ENVIRONMENTAL CONSERVATION
WATERTOWN STATE OFFICE BDG
317 WASHINGTON STREET
WATERTOWN, N.Y. 13601

SUBMITTED BY: SWERDOSKI

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NEW YORK STATE DEPARTMENT OF HEALTH
DIVISION OF LABORATORIES AND RESEARCH
ENVIRONMENTAL HEALTH CENTER

RESULTS OF EXAMINATION
(PAGE 1 OF 1)

AB ACCESSION NO: 80871 YR/MO/DAY/HR SAMPLE REC'D: 80/06/19/16

EPORTINC LAB: 17 EHC ALBANY
ROGPAM: 650 SOLID WASTES
TATION (SOURCE) NO:
RAINAGE BASIN: 09 NY GAZETTEER NO: 4402 COUNTY: ST. LAWRENCE
OORDINATES: DEG ' "N, DEG ' "W
OMMON NAME INCL SUBW'SHED: GRASSE RIVER TPIP TO ST LAWRENCE RIVER
MASSENA
XACT SAMPLING POINT: POWER CANAL DISCHARGE
YPE OF SAMPLE: 61 NAT, OR POLL, SEDIMENT
O/DAY/HR OF SAMPLING: FROM 00/00 TO 06/05/12
EPORT SENT TO: CO (1) RO (1) LPHE (0) LHO (0) FED (0) CHEM (1)

	PARAMETER	UNIT	RESULT	NOTATION
38003	P.C.B., AROCLOR 1016/1242	MCG/G	0.04	
38103	P.C.B., AROCLOR 1254	MCG/G	0.04	
39603	P.C.B., AROCLOR 1221	MCG/G	0.002	LT
39903	MIREX	MCG/G	0.002	LT
41603	P.C.B., AROCLOR 1260	MCG/G	0.002	LT

Sample # 6

ATE COMPLETED: 9/17/80

NYS DEPT. OF ENVIRONMENTAL CONSERVATION
WATERTOWN STATE OFFICE BDG
317 WASHINGTON STREET
WATERTOWN, N.Y. 13601

SUBMITTED BY: SWERDOSKI

0088 NEW YORK STATE DEPARTMENT OF HEALTH 11.15

DIVISION OF LABORATORIES AND RESEARCH

ENVIRONMENTAL HEALTH CENTER

RESULTS OF EXAMINATION

LAB ACCESSION NO: 80872 YR/MO/DAY/HR SAMPLE REC'D: 80/06/19/16

REPORTING LAB: 17 EHC ALBANY
PROGRAM: 650 SOLID WASTES
STATION (SOURCE) NO:
DRAINAGE BASIN: 09 NY GAZETTEER NO: 4469 COUNTY: ST. LAWRENCE
COORDINATES: DEG ' "N. DEG ' "W
COMMON NAME INCL SUBW'SHED: GRASSE RIVER TRIB TO ST LAWRENCE RIVER
MASSENA
EXACT SAMPLING POINT: GRASSE RIVER MOUTH
TYPE OF SAMPLE: 61 NAT. OR POLL. SEDIMENT
MO/DAY/HR OF SAMPLING: FROM 00/00 TO 06/05/12
REPORT SENT TO: CO (1) RO (1) LPME (0) LHO (0) FED (0) CHEM (1)

	PARAMETER	UNIT	RESULT	NOTATION
038003	P.C.B., AROCLOR 1016/1242	MCG/G	1.6	
038103	P.C.B., AROCLOR 1254	MCG/G	0.43	
039803	P.C.B., AROCLOR 1221	MCG/G	0.002	LT
[illegible]903	MIREX	MCG/G	0.002	LT
041603	P.C.B.,AROCLOR 1260	MCG/G	0.002	LT

Sample #3

DATE COMPLETED: 9/17/80

NYS DEPT. OF ENVIRONMENTAL CONSERVATION
WATERTOWN STATE OFFICE BDG
317 WASHINGTON STREET
WATERTOWN, N.Y. 13601

SUBMITTED BY: SWERDOSKI

Reference

12.1

ST. LAWRENCE RIVER
PCB SAMPLING SURVEY
near Massena, New York

Massena (T), St. Lawrence County

September 21, 1982

PARTICIPATING PERSONNEL: New York State Department of Environmental Conservation

Region 6, Watertown

Joseph E. Kuta, Division of Water
William J. Moore, Division of Water

Central Office, Division of Water, Albany

Frank Estabrook, Toxics Assessment Section
Ray Gabriel, Toxics Assessment Section

REPORT PREPARED BY: Joseph E. Kuta, P.E.

Joseph E. Kuta, Senior Sanitary Engineer
NYS Dept. of Environmental Conservation
Region 6 - Watertown
Date: February 22, 1983

12.2

CONTENTS

OBJECTIVE

This field investigation was conducted to perform a water and sediment quality study for a selected portion of the St. Lawrence River near Massena, New York. This study was initially to cover a number of toxic materials, however, due to a shortage of laboratory time and manpower, it was scaled-down to only a PCB-trackdown study.

BACKGROUND

A number of previous PCB-trackdown studies were done near this location, however, no data was ever obtained for this specific area concerning the water and sediments of the St. Lawrence River. The following is a brief list of recent known studies in the area:

- A water quality survey was conducted by Environment Canada in the Summer of 1977 for the St. Lawrence River between Kingston and Cornwall, Ontario.

- International Joint Commission released a report in the Summer of 1979 indicating detectable amounts of PCB's were found in the water column at the mouth of the Grasse River.

- A brief water and sediment quality study for PCB's was done on the Grasse River near the Alcoa plant outfall in August & September 1979 by NYS DEC Central Office Staff.

- MOE (Water Resource Branch) undertook an extensive sediment/water fish survey on the Grasse/St. Lawrence River in the Fall of 1979.

- In the Summer of 1980 a PCB track-down sampling program was conducted on the Grasse River and St. Lawrence River in the Massena area by NYS DEC Region 6 staff.

- Grasse River fish survey/PCB analysis performed by NYS DEC in the summer of 1980.

The above list is not an all inclusive list of PCB-trackdown studies done in the area since 1977, but is only a review of available information in the NYS DEC regional file.

Refer to Appendix I for the justification on this proposed Water/Sediment Quality Survey for the St. Lawrence River.

DISCUSSION

The regional office proposed a sampling program for the St. Lawrence River which included eight sediments and four water samples near the two main industrial dischargers (Reynolds Metals & General Motors/Central Foundry) in the area. These sampling results along with the department's routine toxic surveillance network survey information and a previous Grasse River/Alcoa discharge survey would become a data base. After discussions were held with the Central Office staff additional sampling points were proposed until a total of 11 sediment and 7 water sampling locations were developed (See Appendix 11 for a Location Map and Sample Type). The two sampling sites of the department's routine toxic surveillance network survey near the sampling locations are also noted on the location map in Appendix II.

Equipment used in the survey included the following:

- 16' Boat with outboard motor.

- Miscellaneous safety equipment and wearing apparel such as life jackets, hip boots, rain jackets, etc.

- Coolers with ice for storage and shipping purposes.

- Eleven one liter glass bottles, with teflon lined caps for sediment samples.

- Seven two liter glass bottles, with teflon lined caps for water samples.

- Miscellaneous sampling equipment:

  (1) Stainless steel pail with rope.
  (2) D-handle square end shovel.
  (3) Long handled, home-made sampler scoop.

All sampling bottles were prelabeled and prepared as necessary before the actual sampling was performed. The sampling locations were divided up as listed below:

Sampling Points 6090101, 6090102 & 6090312

- Frank Estabrook sampled from the landside of the water. Samples were obtained by wading into the water.

Sampling Points 6090103 thru 6090110

- Ray Gabriel, Joe Kuta and Bill Moore sampled from the boat. Samples were either taken by wading into the water or directly from the side of the boat. The boat was launched at the Robert Moses State Park Launch Ramp and access to the sampled sites was obtained via Polly's Gut.

The following is a brief description of Mr. Estabrook's sites:

Sampling Point No. 6090101S & 6090101W (Sediment & Water)	- Site was near shore in about 2½ to 3 feet of water at a location upstream of Snell Lock and downstream of Eisenhower Lock.
Sampling Point No. 6090102S & 6090102W (Sediment & Water)	- Sample was taken along the shore line at Massena Point just upstream of Polly's Gut.
Sampling Point No. 6090312S & 6090312W (Sediment & Water)	- Sample was taken in the Raquette River at a bridge crossing near Rooseveltown. The water depth was about 2 to 3 feet deep at the sampling point.

The following sampling methodology was used at the above sites:

Water Sample

Collected one - 2 liter glass bottle, with teflon liner, of surface area water. This sample was collected with minimal turbulence, sealed without air space and chilled immediately with ice to 4° C. The surface was sampled because most PCB contaminated oils would concentrate in this area.

Sediment Sample

Collected in a one-liter glass bottle, with teflon liner. Sought a composite of highly organic sediment by skimming the surface of several deposites in the vicinity of the sampling station. The bottle was sealed without air space, then iced.

The following is a brief description of each location for the second set (Sampling Points 6090105 thru 6090110) of sampling sites, along with some visual observations made during the sampling: (All samples were placed in the proper glass bottles with the teflon lined cap and immediately put in coolers, on ice, as they were completed):

Sampling Point No. 6090103S & 6090103W (Sediment & Water)	- Samples were taken at a small bay downstream from the Grasse River confluence with the St. Lawrence River, across the main channel from Polly's Gut and upstream from the Reynolds outfall. Sampling Methodology was similar to sampling point 6090107.
Sampling Point No. 6090104S (Sediment Only)	- Sample was taken near shore at the southwest end of Cornwall Island. It was difficult to obtain a good sediment sample due to the river bottom composition (very rocky, gravelly and sandy). The sample was taken approximately 50' ± offshore and was obtained by dragging the stainless steel pail along the bottom a number of times until enough sediment was obtained to fill the sampling bottle.
Sampling Point No. 6090105S & 6090105W (Sediment & Water)	- Samples were taken just downstream of the Reynolds Metals Co. treated process wastewater discharge (outfall 001). A very slight, almost non-detectable rainbow sheen could be seen on the water surface. Both samples were taken by a method similar to sampling point 6090107.
Sampling Point No. 6090106S (Sediment Only)	- Sample was taken slightly upstream of the Cornwall International Bridge on the American side. A sampling problem arose concerning the hard bottom (rocks & gravels), the fairly swift current, and the fairly steep "dropoff". Similar sampling procedures as described in other sediment sampling locations were used.

Sampling Point No. 6090107S & 6090107W (Sediment & Water)

Samples were taken just downstream (approximately 100' ±) of the General Motors treated wastewater discharge (outfall 001). The flow in this area was a slow-moving clockwise eddy. A very definite "rainbow sheen" could be seen on the surface of the St. Lawrence River in this area. Also when the bottom sediments were stirred up, an oily film was observed. An extra added precautions of wearing protective gloves, during the sampling process, was taken at this location. The sediment sample was taken by wading into the water and skimming the bottom sediment and then placing it into the sample bottle. The water sample was obtained by dipping the sample bottle directly into the water.

Sampling Point No. 6090108S (Sediment Only)

The planned location was to be as near to Navigational Light #11 as possible, however, the river bottom was very rocky and gravelly and dropped off quickly. Also the swift current near Light #11 caused sampling problems. The actual sample was taken downstream of Light #11 near shore where the bottom (silty-sand) and river current was more conducive to sediment sampling. The sample was obtained by wading into the water with sampling equipment and skimming the bottom sediment, then transferring the sample into the appropriate sample bottle.

Sampling Point No. 6090108W (Water Only)

Sample was taken at approximately mid-channel opposite Light #11 by dipping the stainless steel pail into the water and pouring it into the sample bottle. Again the current in the area was fairly swift.

Sampling Point No. 6090109S (Sediment Only)

Site was downstream of Sampling Point 6090108S near shore, and the bottom sediment was silty-clay. Sample was obtained similar to sampling point 6090108S.

Sampling Point No. 6090110S (Sediment Only)

Sample was taken near (50±) the South shore of Cornwall Island between Directional Light #10 and Light #4. Again the bottom was rocky, gravelly, and sandy and the sample was obtained similar to the other sediment samples.

An additional sediment sample was proposed at a location near the main channel between Raquette Point and Cornwall Island. However, a preliminary study of the location indicated that a sediment sample at this site could not be obtained with the sampling equipment provided.

FINDINGS & RESULTS

All samples were transported on ice in coolers and analyzed at the New York State Department of Health Laboratory in Albany, New York. Refer to Appendix III for the results of this analysis.

The findings indicated no trace of PCB's above detectable limits (0.05 mcg/l for water samples and 0.001 mcg/g for sediment samples) were found at the following sampling points: 6090101W, 6090101S, 6090102W, 6090103W, 6090108W, and 6090512W.

The following sampling results indicated low detectable amounts of PCB's: 6090102S, 6090103S, 6090104S, 6090106S, 6090108S, 6090109S, 6090110S and 6090312S.

Two sites (a total of four samples, 2 water and 2 sediments) indicated higher amounts of PCB's. Both locations were just downstream of the two major industrial dischargers (Reynolds Metals Co. and General Motors/Central Foundry) in the area. The General Motors/Central Foundry site indicated the largest amount of PCB's in both the water (greater than 46 ppb) and sediment (greater than 62 ppm) samples. The Reynolds site sampling results indicated a much lower amount, but still showed comparably high amounts of PCB's in both the water (greater than 1.3 ppb) and sediment (greater than 18 ppm) samples.

APPENDIX I

JUSTIFICATION FOR SURVEY

12.9

Tom Quinn, Monitoring & Surveillance
Bert Mead, Region 6
Justification for Intensive Water Quality Monitoring
Grasse/St. Lawrence River System
June 8, 1982

We feel that local conditions and the possibility of future problems justify an intensive water quality survey for the Grasse/St. Lawrence River system in the Massena area. The following facts were considered in this decision.

1. We have done a very minimal study on the PCB levels sediment in the Grasse River. However, there are other potential PCB sources in the Massena area which discharge to the St. Lawrence River including Reynolds Metals, General Motors-Central Foundry, St. Lawrence Seaway Development Corporation and the New York State Power Authority. It is believed that both General Motors and Reynolds have used PCB materials in the past and in all probability discharges containing PCB's have occurred. New York State has done no work to identify or quantify the PCB's in the environment from these sources. The work that has been done was primarily directed toward ALCOA.

2. The Grasse River discharges as well as the General Motors and Reynolds discharges are upstream of the Akwesasne Indian Reservation. The Indians are very concerned about the effects of PCB's they feel are in the river and have raised the question with the IJC. There is also an ongoing international discussion regarding fluoride contamination of the Akwesasne reservation on Cornwall Island. The potential PCB contamination of the St. Lawrence River will probably be brought into future discussions.

3. There has reportedly been a medical study to determine the body burden of PCB's by reservation residents. Significant levels of PCB's were reportedly found in the resident's fatty tissues. The source of the PCB's is unknown.

4. The reported PCB level in fish from the Massena area exceed the IJC advisory level adopted to protect fish eating birds even though they are generally below FDA levels for human consumption.

5. It appears to me that one significant source of PCB's to the St. Lawrence River may be sediment pick up from the Grasse River which is then distributed along the St. Lawrence River/United States shoreline. We know there are PCB contaminated sediments in the Grasse River and would like to evaluate their effects on the St. Lawrence.

6. General Motors/Central Foundry picks up quite high concentrations of PCB's in their intake water froc the St. Lawrence River at the edge of the shipping channel periodically. It is unknown whether the source of this concentration is from the river itself or if it is caused by resuspension of sediments discharged by General Motors in previous years.

7. We know that General Motors used PCB hydraulic oils and that sludges removed from their historical waste treatment plant have quite high levels of PCB's in them. While it is expected that some PCB's historically have escaped from the treatment plant, we have no quantitative knowledge of this. We feel that sediment sampling in the vicinity of the General Motors discharge, as well as other known discharges is desirable.

8. We know that General Motors has two sludge pits that have been contaminating the immeditately adjacent groundwater. Information on the effects from the runoff from these sludge pits or on groundwater seepage to the St. Lawrence River is desriable but not available.

Very little information on PCB's in the St. Lawrence River system is available. I feel that a detailed water quality study is justified including sediment characteristics for selected portions of the St. Lawrence. Analysis of the Grasse River sediments at the same sites as last sampled are also desirable to determine the changes in sediment contamination levels since the previous sampled.

Considerable planning will be necessary to obtain an effective study at a reasonable cost. The currents in the St. Lawrence River stretch proposed for study are extremely oaeplex. I have attached a photocopy of one current chart of the area and am expecting an additional current chart from the St. Lawrence Seaway Development Authority (SLSDA) via the St. Lawrence Seaway Development Corporation (SLSDC). Other Information would be quite scarce, but relative flows from the Grasse River and Polly's Gut and the mixing currents might be available from either the SLSDA or the SLSDC.

Your support of this study is requested. I would welcome the opportunity to discuss the study goals and resources available at your earliest opportunity. If you can't support the study for this year, a decision that it should not be pursued further would be appreciated as quickly as possible.

If you desire further justification or clarification, please contact me.

Berton E. Mead, P.E.
Regional Engineer
Region 7

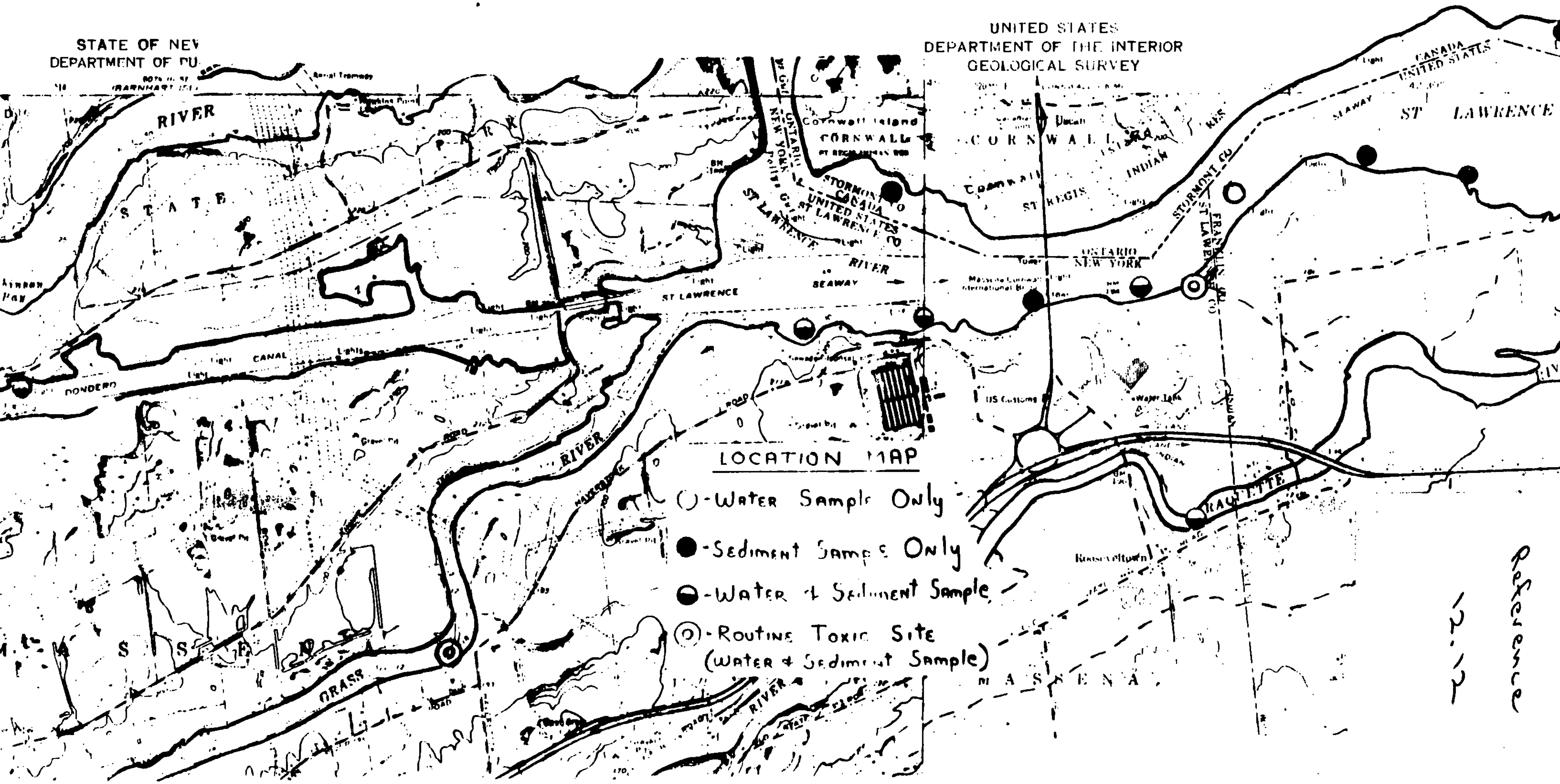
BEM:bw
Attachments

cc: J. Luz
J. Kurta

12.11

APPENDIX II

LOCATION MAP



STATE OF NEW
DEPARTMENT OF PU
UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY
LOCATION MAP
○ - Water Sample Only
● - Sediment Sample Only
◒ - Water + Sediment Sample
◎ - Routine Toxic Site (Water + Sediment Sample)
RIVER
STATE
CANAL
ST LAWRENCE
SEAWAY
CORNWALL
Cornwall Island
ST REGIS
INDIAN
CANADA
UNITED STATES
ONTARIO
NEW YORK
STORMONT CO
ST LAWRENCE CO
FRANKLIN CO
GRASS
RIVER
RAQUETTE
Rooseveltown
MASSENA
Reference
12.12

12.13

APPENDIX III

SAMPLING RESULTS

SAMPLING RESULTS OF PCB - TRACKDOWN STUDY FOR THE ST. LAWRENCE RIVER

SEDIMENT SAMPLES - (Units on all Sediment Samples are mcg/g)

P A R A M E T E R

SAMPLING POINT NO.	PCB AROCLOR 1016/1242	PCB AROCLOR 1254	PCB AROCLOR 1221	PCB AROCLOR 1260	PCB AROCLOR 1248
6090101S	0.001 LT	0.001 LT	0.001 LT	0.001 LT	0.001 LT
6090102S	0.001 LT	0.001 LT	0.001 LT	0.001 LT	0.02
6090103S	0.001 LT	0.001 LT	0.001 LT	0.001 LT	0.01
6090104S	0.001 LT	0.001 LT	0.001 LT	0.001 LT	0.01
6090105S	1.0 LT	1.0 LT	1.0 LT	1.0 LT	18.0
6090106S	0.001 LT	0.001 LT	0.001 LT	0.001 LT	0.05
6090107S	62.0	1.0 LT	1.0 LT	1.0 LT	1.0 LT
6090108S	0.001 LT	0.02	0.001 LT	0.001 LT	0.01
6090109S	0.001 LT	0.001 LT	0.001 LT	0.001 LT	0.02
6090110S	0.001 LT	0.001 LT	0.001 LT	0.001 LT	0.007
6090312S	0.001 LT	0.001 LT	0.001 LT	0.001 LT	0.004

NOTE: Each result which is followed by the designation LT means that the actual results is less than the number reported.

SAMPLING RESULTS OF PCB - TRACKDOWN STUDY FOR THE ST. LAWRENCE RIVER

WATER SAMPLES (Units on all Water Samples are mcg/l)

	PARAMETER			
SAMPLING POINT NO.	PCB AROCLOR 1016/1242	PCB AROCLOR 1254	PCB AROCLOR 1221	PCB AROCLOR 1260
6090101W	0.01 LT	0.05 LT	0.05 LT	0.05 LT
6090102W	0.05 LT	0.05 LT	0.05 LT	0.05 LT
6090105W	0.05 LT	0.05 LT	0.05 LT	0.05 LT
6090105W	1.3	0.07	0.05 LT	0.05 LT
6090107W	41.0	5.8	0.05 LT	0.05 LT
6090108W	0.05 LT	0.05 LT	0.05 LT	0.05 LT
6090312W	0.05 LT	0.05 LT	0.05 LT	0.05 LT

NOTE: Each result which is followed by the designation LT means that the actual results is less than the number reported.

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NEW YORK STATE DEPARTMENT OF HEALTH
DIVISION OF LABORATORIES AND RESEARCH
ENVIRONMENTAL HEALTH CENTER
FINAL REPORT

FINAL REPORT   FINAL REPORT

12.16

RESULTS OF EXAMINATION
(PAGE 1 OF 1)

LAB ACCESSION NO: 22150 YR/MO/DAY/HR SAMPLE REC'D: 82/09/22/15

REPORTING LAB: 17 EHC ALBANY
PROGRAM: 710 TOXIC SUBST, UNIT
STATION (SOURCE) NO:
DRAINAGE BASIN: 09 NY GAZETTEER NO: 4469 COUNTY: ST. LAWRENCE
COORDINATES: DEG ' ", DEG ' "W
COMMON NAME INCL SUBWATSHED: ST LAWRENCE RIVER UPSTREAM OF GRASSE RIVER
ABOVE SNELL LOCK IN MASSENA
EXACT SAMPLING POINT: 6090101
TYPE OF SAMPLE: 21 SURFACE WATER
MO/DAY/HR OF SAMPLING: FROM 00/00 TO 09/21/11
REPORT SENT TO: CO (1) RO (1) LPHE (0) LHO (0) FLD (0) CHEM (1)

PARAMETER		UNIT	RESULT	NOTATION
038009	P.C.B., AROCLOR 1016/1242	MCG/L	0.05	LT
038109	P.C.B., AROCLOR 1254	MCG/L	0.05	LT
039609	P.C.B., AROCLOR 1221	MCG/L	0.05	LT
041609	P.C.B., AROCLOR 1260	MCC/L	0.05	LT

OCT 7 1982
NYS Dept. Env. Cons. Region 6
REGIONAL ENGINEER

DATE PRINTED: 10/04/82

NYS DEPT. OF ENVIRONMENTAL CONSERVATION
WATERTOWN STATE OFFICE BDG
317 WASHINGTON STREET
WATERTOWN, N.Y. 13601

SUBMITTED BY: ESTABROOK

0580.

NEW YORK STATE DEPARTMENT OF HEALTH
DIVISION OF LABORATORIES AND RESEARCH
ENVIRONMENTAL HEALTH CENTER

FINAL REPORT FINAL REPORT FINAL REPORT

RESULTS OF EXAMINATION
(PAGE 1 OF 1)

LAB ACCESSION NO: 22152 YR/MO/DAY/HR SAMPLE REC'D: 82/09/22/15

REPORTING LAB: 17 EHC ALBANY
PROGRAM: 710 TOXIC SUBST. UNIT
STATION (SOURCE) NO:
DRAINAGE BASIN: 09 NY GAZETTEER NO: 4409 COUNTY: ST. LAWRENCE
COORDINATES: DEG ' "N, DEG ' "W
COMMON NAME INCL SUBW'SHED: ST. LAWRENCE RIVER AT MASSENA POINT IN BAY AREA
EXACT SAMPLING POINT: 6095102
TYPE OF SAMPLE: 21 SURFACE WATER
MO/DAY/YR OF SAMPLING: FROM 00/00 TO 09/21/82
REPORT SENT TO: CO (1) RO (1) LPHE (0) LHC (0) FED (0) LHEW (1)

PARAMETER		UNIT	RESULT	NOTATION
036009	P.C.B., AROCLOR 1016/1242	MCG/L	0.05	LT
038109	P.C.B., AROCLOR 1254	MCG/L	0.05	LT
039809	P.C.B., AROCLOR 1221	MCG/L	0.05	LT
041609	P.C.B., AROCLOR 1260	MCG/L	0.05	LT

DATE PRINTED:10/04/82

NYS DEPT. OF ENVIRONMENTAL CONSERVATION
WATERTOWN STATE OFFICE BDG
317 WASHINGTON STREET
WATERTOWN, N.Y. 13601

SUBMITTED BY: ESTABROOK

0581

NEW YORK STATE DEPARTMENT OF HEALTH
DIVISION OF LABORATORIES AND RESEARCH
ENVIRONMENTAL HEALTH CENTER

FINAL REPORT FINAL REPORT FINAL REPORT

RESULTS OF EXAMINATION
(PAGE 1 OF 1)

LAB ACCESSION : 22154 YR/MO/DAY/HR SAMPLE REC'D: 82/09/22/15

REPORTING LAB: 17 EHC ALBANY
PROGRAM: 710 TOXIC SUBST, UNIT
STATION (SOURCE) NO:
DRAINAGE BASIN: 05 NY GAZETTEER NO: 4469 COUNTY: ST. LAWRENCE
COORDINATES: DEG ' "N, DEG ' "W
COMMON NAME INCL SUBWATSHED: ST LAWRENCE RIVER UPSTREAM OF REYNOLDS METAL COMPANY DWNSTRM OF GRASSE R
EXACT SAMPLING POINT: 0590103
TYPE OF SAMPLE: 21 SURFACE WATER
MO/DAY/HR OF SAMPLING: FROM 00/00 TO 09/21/14
REPORT SENT TO: CO (1) RO (1) LPHE (0) LHO (0) FED (0) CHEM (1)

PARAMETER		UNIT	RESULT	NOTATION
036009	P.C.B., AROCLOR 1016/1242	MCG/L	0.05	LT
036109	P.C.B., AROCLOR 1254	MCG/L	0.05	LT
038609	P.C.B., AROCLOR 1221	MCG/L	0.05	LT
041609	P.C.B., AROCLOR 1260	MCG/L	0.05	LT

OCT 7 1982
NYS DEPT. E.C.
REGIONAL ENGINEER

DATE PRINTED:10/04/82

NYS DEPT. OF ENVIRONMENTAL CONSERVATION
WATERTOWN STATE OFFICE BDG
317 WASHINGTON STREET
WATERTOWN, N.Y. 13601

SUBMITTED BY: FETAPPO

1382

NEW YORK STATE DEPARTMENT OF HEALTH
DIVISION OF LABORATORIES AND RESEARCH
ENVIRONMENTAL HEALTH CENTER

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RESULTS OF EXAMINATION
(PAGE 1 OF 1)

LAB ACCESSION NO: 22156   YR/MO/DAY/HR SAMPLE REC'D: 82/09/22/15

REPORTING LAB: 17 EHC ALBANY
PROGRAM: 710 TOXIC SUBST. UNIT
STATION (SOURCE) NO:
DRAINAGE BASIN: 09 NY GAZETTEER NO: 4469 COUNTY: ST. LAWRENCE
COORDINATES: DEG ' "N, DEG ' "W
COMMON NAME INCL SUBW'SHED: ST LAWRENCE R AT REYNOLDS METAL CO OUTFALL IN MASSENA
EXACT SAMPLING POINT: 6090103W
TYPE OF SAMPLE: 21 SURFACE WATER
MO/DAY/HR OF SAMPLING: FROM 00/00 TO 09/21/14
REPORT SENT TO: CO (1) RO (1) LPHE (0) LHO (0) FED (0) CHEM (1)

	PARAMETER	UNIT	RESULT	NOTATION
036009	P.C.B., AROCLOR 1016/1242	MCG/L	1.3	
035109	P.C.B., AROCLOR 1254	MCG/L	0.07	
039609	P.C.B., AROCLOR 1221	MCG/L	0.05	LT
041609	P.C.B., AROCLOR 1260	MCG/L	0.05	LT

DATE PRINTED:10/04/82

NYS DEPT. OF ENVIRONMENTAL CONSERVATION
WATERTOWN STATE OFFICE BDG
317 WASHINGTON STREET
WATERTOWN, N.Y. 13601

SUBMITTED BY: FSTARROOK

DSBS

NEW YORK STATE DEPARTMENT OF HEALTH
DIVISION OF LABORATORIES AND RESEARCH
ENVIRONMENTAL HEALTH CENTER

FINAL REPORT FINAL REPORT FINAL REPORT

1200 12.20
St. Lawrence River
Grasse River
PCB
Trackdown

RESULTS OF EXAMINATION
(PAGE 1 OF 1)

LAB ACCESSION NO: 22101 YR/MO/DAY/HR SAMPLE REC'D: 82/09/22/15

REPORTING LAB: 17 EHC ALBANY
PROGRAM: 710 TOXIC SUBST. UNIT
STATION (SOURCE) NO:
DRAINAGE BASIN: 09 NY GAZETTEER NO: 4469 COUNTY: ST. LAWRENCE
COORDINATES: DEG ' "N. DEG ' "W
COMMON NAME INCL SUBW'SHED: ST LAWRENCE RIVER DOWNSTREAM OF GENERAL MOTORS OUTFALL IN MASSENA
EXACT SAMPLING POINT: ~~6090107~~
TYPE OF SAMPLE: 21 SURFACE WATER
MO/DAY/HR OF SAMPLING: FROM 00/00 TO 09/21/13
REPORT SENT TO: CO (1) RO (1) LCHE (0) LHO (0) FED (0) CHEM (1)

PARAMETER		UNIT	RESULT	NOTATION
038009	P.C.B., AROCLOR 1016/1242	MCG/L	41.	
038109	P.C.B., AROCLOR 1254	MCG/L	5.6	
039609	P.C.B., AROCLOR 1221	MCG/L	0.05	LT
041609	P.C.B., AROCLOR 1260	MCG/L	0.05	LT

Conservation Region 6 REGIONAL ENGINEER

DATE PRINTED: 10/04/82

NYS DEPT. OF ENVIRONMENTAL CONSERVATION
WATERTOWN STATE OFFICE BDG
317 WASHINGTON STREET
WATERTOWN, N.Y. 13601

SUBMITTED BY: ESTABROOK

NEW YORK STATE DEPARTMENT OF HEALTH
DIVISION OF LABORATORIES AND RESEARCH
ENVIRONMENTAL HEALTH CENTER
FINAL REPORT

...AL REPORT FINAL REPORT

12.21

RESULTS OF EXAMINATION
(PAGE 1 OF 1)

... : 22107 ... SAMPLE REC'D: 02/09/22/15

...PORTING EARS: 17 EHC ALBANY
...GRAM: 710 TOXIC SUBST. UNIT
...TION (SOURCE) NO:
...NAGE BASIN: 09 NY GAZETTEER NO: 4469 COUNTY: ST. LAWRENCE
...RDINATES: DEG ' " N, DEG ' " W
...ION NAME INCL SUBN'SHED: RAQUETTE RIVER IN ROOSEVELTOWN

...T SAMPLING POINT: 6090312A
... OF SAMPLE: 21 SURFACE WATER
...DAY/HR OF SAMPLING: FROM 00/00 TO 09/21/12
...RT SENT TO: CO (1) RE (1) LPHE (0) LHO (0) FED (0) CHEM (1)

	PARAMETER	UNIT	RESULT	NOTATION
...109	P.C.B., AROCLOR 1016/1242	MCG/L	0.05	LT
...109	P.C.B., AROCLOR 1254	MCG/L	0.05	LT
...609	P.C.B., AROCLOR 1221	MCG/L	0.05	LT
...609	P.C.B., AROCLOR 1260	MCG/L	0.05	LT

... PRINTED:10/04/82

NYS DEPT. OF ENVIRONMENTAL CONSERVATION
WATERTOWN STATE OFFICE BDG
317 WASHINGTON STREET
WATERTOWN, N.Y. 13601

SUBMITTED BY: ESTABROOK

0#86 \2.22

NEW YORK STATE DEPARTMENT OF HEALTH
DIVISION OF LABORATORIES AND RESEARCH
ENVIRONMENTAL HEALTH CENTER

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RESULTS OF EXAMINATION
(PAGE 1 OF 1)

LAB ACCESSION NO: 22131 YR/MO/DAY/HR SAMPLE REC'D: 82/09/22/13

REPORTING LAB: 17 EHC ALBANY
PROGRAM: 71_ TOXIC SUBST. UNIT
STATION (SOURCE) NO:
DRAINAGE BASIN: 09 NY GAZETTEER NO: 4469 COUNTY: ST. LAWRENCE
COORDINATES: DEG ' "N, DEG ' "W
COMMON NAME INCL SUBW'SHED: ST LAWRENCE RIVER UPSTREAM OF GRASSE RIVER
ABOVE SNELL LOCK IN MASSENA
EXACT SAMPLING POINT: 609010IS
TYPE OF SAMPLE: 61 NAT. OR POLL. SEDIMENT
MO/DAY/HR OF SAMPLING: FROM 00/00 TO 09/21/11
REPORT SENT TO: CO (1) RO (1) LPHE (0) LHO (0) FED (0) CHEM (1)

PARAMETER		UNIT	RESULT	NOTATION
038003	P.C.B., AROCLOR 1016/1242	MCG/G	0.001	LT
038103	P.C.B., AROCLOR 1254	MCG/G	0.001	LT
039803	P.C.B., AROCLOR 1221	MCG/G	0.001	LT
_1603	P.C.B., AROCLOR 1260	MCG/G	0.001	LT
032203	P.C.B., AROCLOR 1248	MCG/G	0.001	LT

DATE PRINTED: 10/14/82

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NEW YORK STATE DEPARTMENT OF HEALTH
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RESULTS OF EXAMINATION
(PAGE 1 OF 1)

LAB ACCESSION NO: 22133 YR/MO/DAY/HR SAMPLE REC'D: 82/09/22/13

REPORTING LAB: IT EHC ALBANY
PROGRAM: 710 TOXIC SUBST. UNIT
STATION (SOURCE) NO:
DRAINAGE BASIN: 09 NY GAZETTEER NO: 4469 COUNTY: ST. LAWRENCE
COORDINATES: DEG ' "N, DEG ' "W
COMMON NAME INCL SUBW'SHED: ST LAWRENCE RIVER AT MASSENA POINT IN BAY AREA
EXACT SAMPLING POINT: 6090102S
TYPE OF SAMPLE: 61 NAT. OR POLL. SEDIMENT
MO/DAY/HR OF SAMPLING: FROM 00/00 TO 09/21/11
REPORT SENT TO: CO (1) RO (1) LPHE (0) LHD (0) FED (0) CHEM (1)

PARAMETER		UNIT	RESULT	NOTATION
038003	P.C.B.. AROCLOR 1016/1242	MCG/G	0.001	LT
038103	P.C.B.. AROCLOR 1254	MCG/G	0.001	LT
039803	P.C.B.. AROCLOR 1221	MCG/G	0.001	LT
041603	P.C.B.. AROCLOR 1260	MCG/G	0.001	LT
0?2203	P.C.B.. AROCLOR 1246	MCG/G	0.02	

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RESULTS OF EXAMINATION
(PAGE 1 OF 1)

LAB ACCESSION NO: 22133 YP/MO/DAY/HR SAMPLE REC'D: 82/09/22/13

REPORTING LAB: IT EHC ALBANY
PROGRAM: 710 TOXIC SUBST. UNIT
STATION (SOURCE) NO:
DRAINAGE BASIN: 09 NY GAZETTEER NO: 4469 COUNTY: ST. LAWRENCE
COORDINATES: DEG ' "N, DEG ' "W
COMMON NAME INCL SUBW'SHED: ST LAWRENCE RIVER UPSTRLAM OF REYNOLDS METAL CO DWNSTRM GRASSE R
EXACT SAMPLING POINT: 60901035
TYPE OF SAMPLE: 61 NAT. OF POLL. SEDIMENT
MO/DAY/HR OF SAMPLING: FROM 00/00 TO 09/21/14
REPORT SENT TO: CO (1) RO (1) LPME (0) LHO (0) FEU (0) CHEM (1)

PARAMETER		UNIT	RESULT	NOTATION
038003	P.C.B., AROCLOR 1016/1242	MCG/G	0.001	LT
036103	P.C.B., AROCLOR 1254	MCG/G	C.001	LT
039803	P.C.B., AROCLOR 1221	MCG/G	0.001	LT
041603	P.C.B., AROCLOR 1260	MCG/G	0.001	LT
052203	P.C.B., AROCLOR 1246	MCG/G	0.01	

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AL REPORT

NEW YORK STATE DEPARTMENT OF HEALTH
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RESULTS OF EXAMINATION
(PAGE 1 OF 1)

ACCESSION NO: 22156 YR/MO/DAY/HR SAMRLE REC'D: 82/09/22/15

ORTING LAB: 17 EHC ALBANY
GRAM: 71 TOXIC SUBST, UNIT
TION (SOURCE) NO:
AINAGE BASIN: 09 NY GAZETTEER NO: 4469 COUNTY: ST, LAWRENCE
RDINATES: DEG ' "N, DEG ' "W
MON NAME INCL SUBW'SHED: ST LAWRENCE RIVER NEAR CORNWALL IS CANADA ACROSS FROM REYNOLDS METAL
T SAMPLING POINT: 60901045
OF SAMPLE: 61 NAT. OR POLL, SEDIMENT
DAY/HR OF SAMPLING: FROM 00/00 TO 09/21/10
RT SENT TO: CO (1) RO (1) LPHE (0) LHO (0) FEL (0) CHEM (1)

PARAMETER		UNIT	RESULT	NOTATION
003	P.C.B., AROCLOR 1016/1242	MCG/G	0.001	LT
105	P.C.B., AROCLOR 1254	MCG/G	0.001	LT
9603	P.C.B., AROCLOR 1221	MCG/G	0,001	LT
03	P.C.E.,AROCLOR 1260	MCG/G	0,001	LT
203	P.C.B.,AROCLOR 1246	MCG/G	0,01	

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517 WASHINGTON STREET
WATERTONN, N.Y. 13601

SUBMITTED BY: ESTABROOK

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DIVISION OF LABORATORIES AND RESEARCH
ENVIRONMENTAL HEALTH CENTER

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RESULTS OF EXAMINATION
(PAGE 1 OF 1)

LAB ACCESSION NO: 22157 YR/MO/DAY/HR SAMRLE REC'D: 82/09/22/15

REPORTING LAB: 17 EHC ALBANY
PROGRAM: 710 TOXIC SUBST. UNIT
STATION (SOURCE) NO:
DRAINAGE BASIN: 09 NY GAZETTEER NO: 4469 COUNTY: ST. LAWRENCE
COORDINATES: DEG ' "N, DEG ' "W
COMMON NAME INCL SUBW'SHED: ST LAWRENCE RIVER AT REYNOLDS METAL CO
OUTFALL IN MASSENA
EXACT SAMPLING POINT: 60901055
TYPE OF SAMPLE: 61 NAT. OR POLL. SEDIMENT
MO/DAY/HR OF SAMPLING: FROM 00/00 TO 09/21/14
REPORT SENT TO: CO (1) RO (1) LPHE (0) LHO (0) FED (0) CHEM (1)

PARAMETER		UNIT	RESULT	NOTATION
058003	P.C.B., AROCLOR 1016/1242	MCG/G	1.0	LT
058103	P.C.B., AROCLOR 1254	MCG/G	1.0	LT
059803	P.C.5., AROCLOR 1221	MCC/G	1.0	LT
0[illegible]03	P.C.B., AROCLOR 1260	MCG/G	1.0	LT
052203	P.C.B., AROCLOR 1246	MCG/G	16.	

DATE PRINTED: 10/14/82

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NEW YORK STATE DEPARTMENT OF HEALTH
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RESULTS OF EXAMINATION
(PAGE 1 OF 1)

LAB ACCESSION NO: 22159 YR/MO/DAY/HR SAMPLE REC'D: 82/09/22/15

REPORTING LAB: 17 EHC ALBANY
PROGRAM: 710 TOXIC SUBST. UNIT
STATION (SOURCE) NO:
DRAINAGE BASIN: 09 NY GAZETTEER NO: 4469 COUNTY: ST. LAWRENCE
COORDINATES: DEG ' "N, DEG ' "W
COMMON NAME INCL SUBWSHED: ST LAWRENCE RIVER UPSTREAM OF GMC BETWEEN REYNOLDS AND GMC IN MASSENA
EXACT SAMPLING POINT: 6090106S
TYPE OF SAMPLE: 61 NAT. OR POLL. SEDIMENT
MO/DAY/HR OF SAMPLING: FROM 00/00 TO 09/21/13
REPORT SENT TO: CO (1) RO (1) LPHE (0) LHO (0) FED (0) CHEM (1)

PARAMETER		UNIT	RESULT	NOTATION
058003	P.C.B., AROCLOR 1016/1242	MCG/G	0.001	LT
058103	P.C.B., AROCLOR 1254	MCG/G	0.001	LT
059803	P.C.B., AROCLOR 1221	MCG/G	0.001	LT
061603	P.C.B., AROCLOR 1260	MCG/G	0.001	LT
052203	P.C.B., AROCLOR 1248	MCG/G	0.05	

DATE PRINTED: 10/14/82

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WATERTOWN STATE OFFICE BDG
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SUBMITTED BY: ESTABROOK

0492 NEW YORK STATE DEPARTMENT OF HEALTH 12.28
DIVISION OF LABORATORIES AND RESEARCH
ENVIRONMENTAL HEALTH CENTER

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RESULTS OF EXAMINATION
(PAGE 1 OF 1)

LAB ACCESSION NO: 22160 YR/MO/DAY/HR SAMPLE REC'D: 82/09/22/15

REPORTING LAB: 17 EHC ALBANY
PROGRAM: 716 TOXIC SUBST. UNIT
STATION (SOURCE) NO:
DRAINAGE BASIN: 09 NY GAZETTEER NO: 4469 COUNTY: ST. LAWRENCE
COORDINATES: DEG ' "N, DEG ' "W
COMMON NAME INCL SUPWISHED: ST LAWRENCE RIVER DWNSTRM OF GENERAL MOTORS
OUTFALL IN MASSENA
EXACT SAMPLING POINT: 6C901078
TYPE OF SAMPLE: 61 NAT. OR POLL. SEDIMENT
MO/DAY/HR OF SAMPLING: FROM 00/00 TO 08/21/13
REPORT SENT TO: CO (1) RO (1) LPHE (0) LHO (0) FED (0) CHEM (1)

PARAMETER		UNIT	RESULT	NOTATION
038003	P.C.B., AROCLOR 1016/1242	MCG/G	62.	
038103	P.C.E., AROCLOR 1254	MCG/G	1.0	LT
039603	P.C.B., AROCLOR 1221	MCG/G	1.0	LT
[illegible]603	P.C.B., AROCLOR 1260	MCG/G	1.0	LT
052203	P.C.B., AROCLOR 1248	MCG/G	1.0	LT

DATE PRINTED: 10/14/82

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RESULTS OF EXAMINATION
(PAGE 1 OF 1)

LAB ACCESSION NO: 22166 YR/MO/DAY/HR SAMPLE REC'D: 82/09/22/13

REPORTING LAB: 17 EHC ALBANY
PROGRAM: 710 TOXIC SUBST. UNIT
STATION (SOURCE) NO:
DRAINAGE BASIN: 09 NY GAZETTEER NO: 4469 COUNTY: ST. LAWRENCE
COORDINATES: DEG ' "N, DEG ' "W
COMMON NAME INCL SUBW'SHED: RAQUETTE RIVER IN ROOSEVELTOWN

EXACT SAMPLING POINT: 6090312S
TYPE OF SAMPLE: 61 NAT. OR POLL. SEDIMENT
MO/DAY/HR OF SAMPLING: FROM 00/00 TO 09/21/12
REPORT SENT TO: CO (1) RO (1) LPHL (0) LHO (0) FED (0) CHEM (1)

	PARAMETER	UNIT	RESULT	NOTATION
038003	P.C.B., AROCLOR 1016/1242	MCG/G	0.001	LT
038103	P.C.B., AROCLOR 1254	MCG/G	0.001	LT
039803	P.C.B., AROCLOR 1221	MCG/G	0.001	LT
041603	P.C.B., AROCLOR 1260	MCG/G	0.001	LT
052203	P.C.B., AROCLOR 1246	MCG/G	0.004	

DATE PRINTED: 10/14/82

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WATERTOWN STATE OFFICE BDG
317 WASHINGTON STREET
WATERTOWN, N.Y. 13601

SUBMITTED BY: ESTABROOK

15 (12-75)

Reference 13.1

New York State Department of Environmental Conservation

MEMORANDUM

TO: Joe Forti
FROM: Darrell Sweredoski
SUBJECT: REYNOLDS METALS FACILITY - MASSENA

DATE: December 11, 1986

I have received your December 8, 1986 memo on the above subject, and, from my viewpoint as an engineer, I cannot agree with some of your conclusions.

On August 20, our water technician and I sampled water and sediment in the St. Lawrence River with the narrow objective of defining conditions upstream, downstream, and at Reynold's two main discharge points. Sites 3s and 4s were at very close proximity to the Reynold's discharge points. (See attached memo).

The water analysis was inconclusive, as might have been expected. However, the sediment analysis gave a much different picture:

1s (upstream) PCB - 1.3 ppm
PNA - 7.45 ppm

2s (downstream) PCB - 2.4 ppm
PNA - 32.1 ppm

3s (Reynolds process waters discharge) PCB - 19.7 ppm
PNA* - 654 ppm

4s (Reynolds cooling & sanitary discharge) PCB - 13.7 ppm
PNA* - 55.24 ppm

* Many other unidentified BNA's

In my opinion, there is a marked increase in PCB concentration at the Reynold's discharges, and the contaminate levels trailing off downgradient. The PNA levels at 654 ppm speak for themselves.

\3.2

New York State Department of Environmental Conservation

MEMORANDUM

TO: Mark Millsapugh, Environmental Enforcement
FROM: Darrell Sweredoski, Region 6 - Watertown
SUBJECT: RIVER SAMPLING, REYNOLDS METALS
DATE: August 21, 1986

On August 20, 1986 Bill Moore and I sampled water and sediment for priority pollutants in the Reynolds' vicinity. Air temperature was about 75°F, clear skies, wind out of the northeast. The object of our sampling was to determine if PCB's and other pollutants in the St. Lawrence could be traced back to Reynolds discharges. The sample locations and sample descriptions are attached.

On August 21, 1986 samples were shipped via Federal Express to Weston Labs, Pennsylvania.

Darrell M. Sweredoski

Darrell M. Sweredoski, P.E.
Sr. Sanitary Engineer
Division Solid & Hazardous Waste

DMS:kw
Attachments

cc: Jim Luz
Bill Moore

[illegible] I do not disagree with your statement that "Additional investigations should be performed by the Department to determine the sources and scope of the contamination problem in the River," I must bring to your attention that Reynold's is a very large user of coal tar in their process (30 million pounds per year in 1977), and high levels of coal tar derivitives (PNA's) are located at their discharge points.

Darrell M. Sweredoski, P.E.
Sr. Sanitary Engineer
Region 6

DMS:sgs

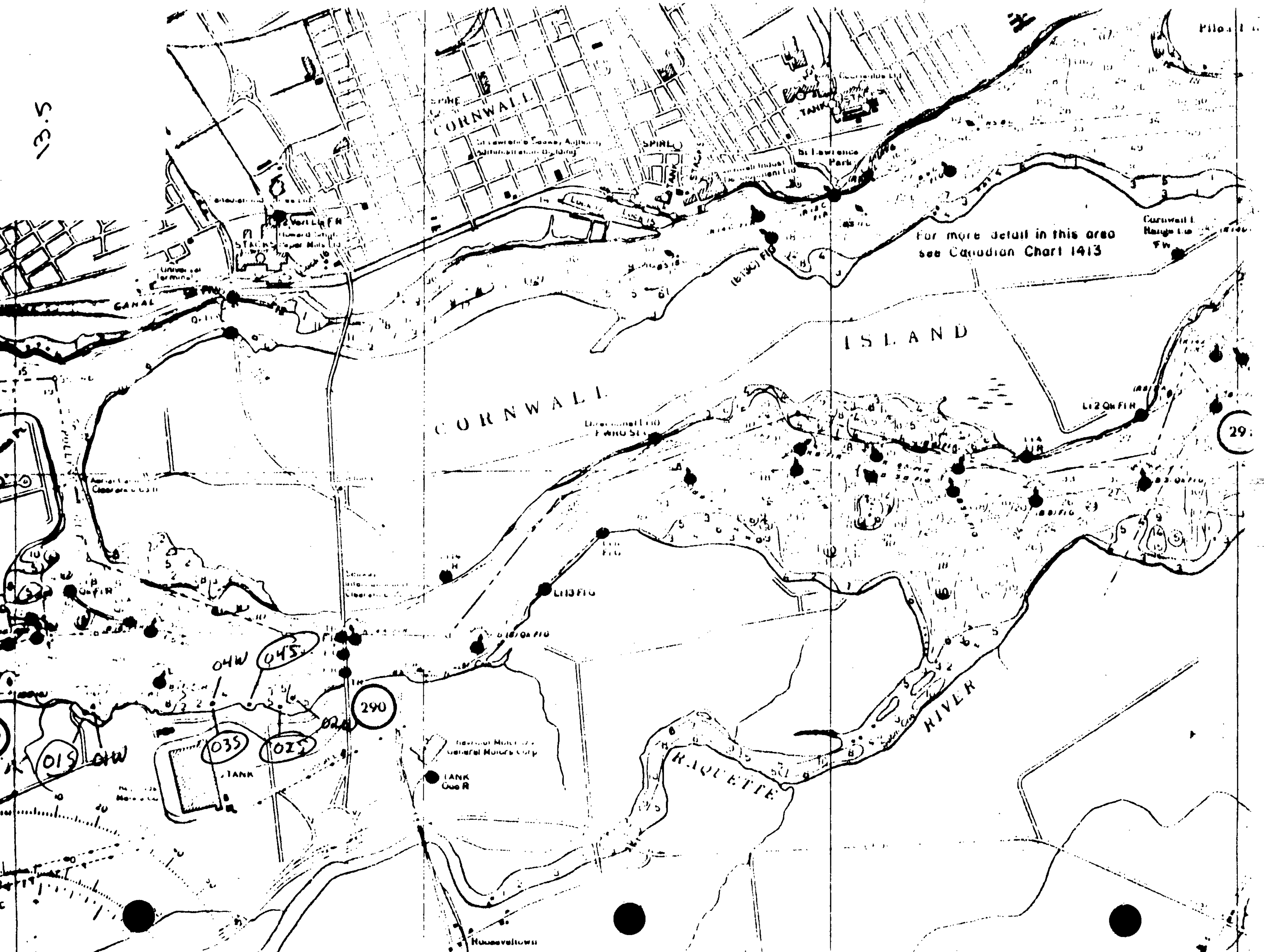
cc: J. Kenna
N. Millspaugh
[illegible]
J. Iannotti
M. Kautz

Att.

REYNOLDS METALS
WATER & SEDIMENT SAMPLES
[illegible]

SITE #	DEPTH	DISTANCE TO SHORE, LANDMARK
01S	~10'	100' to shore, ~middle of bay; ponar sample; black organic muck; 11:45 AM
01W	Sampled at ~10' depth; 10/52 AM to 12:06 PM	Vandoran sample at mouth of bay; mid-point
02S	Sampled at ~4'; 12:20 PM	~50' from shore, ~200' from west end of bay; ponar sample; sandy, silty, dark color, stoney bottom; ~6" sediment
02W	Sampled at ~8'; 12:35-12:50 PM	Vandoran sample at mouth of bay, mid-point
04W	Sampled at 10'; 1:10-1:20 PM	Vandoran sample; ~100' from shore; 300' below outfall 001, Reynolds
03S	~15' depth; 1:20-1:30 PM	Sample location same as 04W; fine black muck, organic; ~1½' deep sediment
04S	~6' depth; 1:35-1:50 PM	Cooling water outfall 002 bay; ~100' off shore, center of bay; 1½' sediment; sandy, silty, dark color, organic; slight sheen on dredge sample

13.5



CORNWALL
SPIRE
St Lawrence Seaway Authority Administration Building
SPIRE
St Lawrence Park
TANK
Universal Terminal
CANAL
For more detail in this area see Canadian Chart 1413
Cornwall I. Range Lts
ISLAND
CORNWALL
LT2 Qk Fl R
LH13 Fl G
290
04W
045
035
025
02W
015
01W
TANK
General Motors Corp
TANK Occ R
RAQUETTE
RIVER
Rooseveltown

Reference

14.1

Uncontrolled Hazardous Waste Site Ranking System

A Users Manual
(HW-10)

Originally Published in
the July 16, 1982, *Federal Register*

United States
Environmental Protection
Agency

1984

14.2

TABLE 2

PERMEABILITY OF GEOLOGIC MATERIALS*

Type of Material	Approximate Range of Hydraulic Conductivity	Assigned Value
Clay, compact till, shale; unfractured metamorphic and igneous rocks	$<10^{-7}$ cm/sec	0
Slit, loess, silty clays, silty loams, clay loams; less permeable limestone, dolomites, and sandstone; moderately permeable till	10^{-5} - 10^{-7} cm/sec	1
Fine sand and silty sand; sandy loams; loamy sands; moderately permeable limestone, dolomites, and sandstone (no karst); moderately fractured igneous and metamorphic rocks, some coarse till	10^{-3} - 10^{-3} cm/sec	2
Gravel, sand; highly fractured igneous and metamorphic rocks; permeable basalt and lavas; karst limestone and dolomite	$>10^{-3}$ cm/sec	3

*Derived from:

Davis, S. N., Porosity and Permeability of Natural Materials In Flow-Through Porous Media, R.J.M. DeWest ed., Academic Press, New York, 1969

Freeze, R.A. and J.A. Cherry, Groundwater, Prentice-Hall, Inc., New York, 1979

Reference 15.1

WASTE SITE INVESTIGATION ALCOA MASSENA OPERATIONS

VOLUME I - INVESTIGATIVE REPORT

SUBMITTED TO

NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION

Albany, New York

SUBMITTED BY

ALUMINUM COMPANY OF AMERICA
Massena, New York

ES ENGINEERING-SCIENCE
Liverpool, New York

MARCH 1987

15.2

EXECUTIVE SUMMARY

The Aluminum Company of America (ALCOA) owns and operates an aluminum and aluminum product production facility in the Town of Massena, County of St. Lawrence, State of New York. Massena is a rural area of the state with a population of approximately 15,000 people. The facility encompasses approximately 3,500 acres and includes a Fabricating Area (Area 1), Ingot-Extrusion Area (Area 2), a Smelting Area (Area 3) and eleven (11) disposal areas. The facility is bordered on the north by the St. Lawrence River, the southwest by the Massena Power Canal, and on the southeast by the Grasse River (Figure 1). A residential area is located along Dennison Cross Road which generally parallels the northeastern boundary.

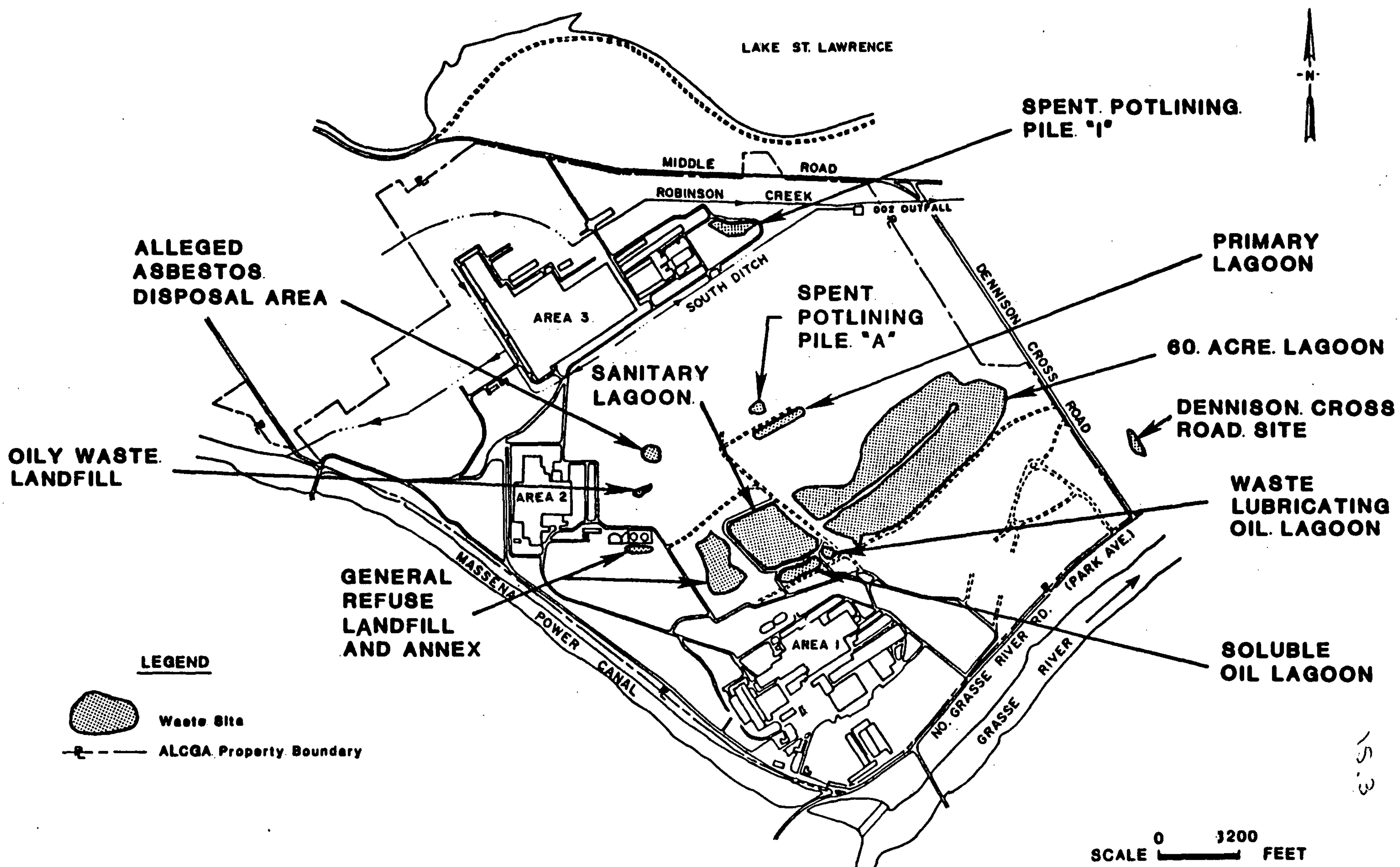
ALCOA began operations at the Massena Facility around 1903. As a result of production activities, ALCOA has disposed of certain industrial wastes at various locations on the site. The New York State Department of Environmental Conservation (NYSDEC) in accordance with the Environmental Control Law (ECL), Article 27, Title 13, alleged the facility to be an inactive hazardous waste disposal site, as defined in the ECL, and that the hazardous and/or industrial wastes at the site constitute a significant threat to the environment pursuant to the ECL Article 27, Title 13. Effective January 16, 1985, ALCOA and the NYSDEC entered into a Consent Order whereby ALCOA agreed to develop and implement an inactive hazardous waste disposal site remedial program subject to the approval of the NYSDEC.

OBJECTIVES AND SCOPE OF THE INVESTIGATION

The objectives of this investigation are to (1) identify any past, current and/or potential future releases or migration of hazardous waste, as defined in the ECL, from the site, and (2) to evaluate the impacts of ALCOA's past and present handling and/or disposal of hazard-

SITE PLAN

ALCOA - Massena, N.Y.



-2-

ES ENGINEERING-SCIENCE

15.3

FIGURE 1

ous and/or industrial waste including impacts both on-site and off-site. For the purposes of this study, off-site refers to those areas which may have been affected or impacted by disposal and/or handling of hazardous and/or industrial wastes within the immediate vicinity of the site and does not include any off-site waste disposal sites to which ALCOA or its agents may have sent wastes for disposal.

Based upon the findings of this site investigation, ALCOA is to develop and implement an inactive hazardous waste disposal site remedial program, as defined in the ECL. The goal for the inactive hazardous waste disposal site remedial program shall be to identify, and if necessary, to mitigate or eliminate any present or potential future threat to the environment at the site and at affected off-site areas.

In May 1985, O'Brien & Gere Engineers, Inc., of Syracuse, NY prepared a revised investigation proposal (RIP) for ALCOA in accordance with the Consent Order. The RIP provided the work plan under which ALCOA conducted the Waste Site Investigation Program at the Massena Operations. During the summer and fall of 1985, ALCOA and O'Brien & Gere Engineers, Inc., completed Phase I of the project which included the site survey, hydrogeological investigation, and geophysical surveys as described in Appendix B. During 1986, ALCOA and Engineering-Science (ES) completed the environmental media sampling (leachate, test pit soils, surface water, sediments, and groundwater), data analysis, and interpretation as part of Phase II and Phase III of the same program. All laboratory analyses were conducted by NUS Corporation of Pittsburgh, Pennsylvania.

ENVIRONMENTAL SETTING

The ALCOA Massena facility is located within the Oriented Till Ridges Subsection of the St. Lawrence Lowland physiographic province.

Surface soils are variable in their drainage characteristics, ranging from well to moderately-well drained for soils derived from till deposits to poorly-drained soils derived from fine-grained alluvium and sediments occupying the stream valleys and lowlands.

The major drainage features at the ALCOA site are the Grasse River, the Massena Power Canal, Robinson Creek, and the South Ditch. Runoff to the Power Canal is derived from a large area in the western portion of the plant and channeled to the Power Canal via the 003 Outfall. The central portion of the site drains to the Grasse River via man-made ditches and sewer lines. The northern half of the site drains to Robinson Creek and the South Ditch. The eastern portion of the site drains to an unnamed tributary to the Grasse River.

The surface geology of the ALCOA facility is characterized by a thick sequence of unconsolidated glacial drift overlying dolomite bed-rock. The drift is composed of till, lacustrine clay and silt, and marine deposits which form the upper, middle, and lower till units. Ground water occurs under both water-table (unconfined ground-water conditions) and confined conditions (under pressure). The water-table aquifer occurs at depths of less than 10 feet within the upper till unit. Groundwater under confined conditions occurs at depths of 50 feet or more within the middle and lower till units (drift aquifers) and the bedrock (bedrock aquifer).

The water-table aquifer is recharged by precipitation along the till ridges and discharges to the valleys and local streams. Ground water divides occur in the water-table aquifer along the ridge tops and east of the 60 Acre Lagoon. Ground-water flow within the water-table aquifer on the southwest portion of the ALCOA site and south side of the southern ridge will be to the south toward the Grasse River, on the north side of the central ridge toward the South Ditch, between the two ridges toward the 60 Acre Lagoon, and east of the 60 Acre Lagoon to an unnamed tributary to the Grasse River.

Ground-water flow within the drift aquifers cannot be determined with available data. Comparison of water levels in the water-table wells with levels in the deeper confined drift aquifers suggest that drift aquifers may be recharged locally by the water-table aquifer. Discharge from the drift aquifers occur by lateral flow to seeps along valley margins.

Ground-water flow in the bedrock aquifer beneath all parts of the ALCOA site is expected to be south toward the Grasse River. The bedrock receives recharge from the overlying drift aquifers and discharges to the Grasse River.

Locally, ground water is used for domestic purposes in areas outside the distribution limits of the Village of Massena. Residents in the area bounded by the St. Lawrence Seaway to the northeast, Donaghue Road to the east, the Grasse River to the southeast, and the Massena Power Canal to the southeast use ground-water wells for their water supplies. Most of the wells in the vicinity of the ALCOA facility are within the till, although several wells are in the bedrock. No industrial wells are known to occur within a three-mile radius of the center of the facility.

DESCRIPTION OF SITE CONTAMINATION

A concise disposal area description including leachate, ground water, and test pit soil analysis is summarized for the eleven disposal sites under investigation in Table 1. Sitewide contamination is addressed herein.

Ground Water

Ground water contamination was detected in several of the shallow monitoring wells on the facility during the Phase II field investigation. No elevated levels of contaminants were collected in the deep monitoring wells at the facility. This data coupled with groundwater hydrology and contaminant characteristics was used to assess the extent of contamination and migration in ground water.

- Ground water in the water-table aquifer from the area of the Spent Potlining Pile "I" migrates in an east-southeasterly direction toward the South Ditch and Robinson Creek. At this location, the South Ditch drains to the 002 Outfall. Benzo(b)fluoranthene (2 ug/l) and total cyanide (0.034-2.6 mg/l) were the contaminants detected in on-site wells in this area at levels greater than NYSDEC Ground Water Quality Standards. Benzo(b)fluoranthene has a strong tendency to adsorb to organic matter and a low water solubility which renders it relatively immobile. Although the amount of free and complexed cyanide is unknown, free cyanide is rapidly converted to carbon dioxide and ammonia by soil bacteria and fungi and complexed cyanide salts are fairly insoluble. Hence, neither compound is expected to migrate as far as the residential well locations near Robinson Creek at the corner of Route 131 and Dennison Cross Road.

TABLE 1
SUMMARY OF DISPOSAL SITE DESCRIPTIONS

Area Name	Current Status	Type of Site and Size	Waste Material and Quantity	Environmental Setting	Waste Sampling[1]	Environmental Sampling[2]
Alleged Asbestos (Dross) Disposal Area #645006	Inactive, active from 1955-1965	landfill 1.75 Acres	Dross and other industrial wastes 0-12' thick. Exact quantity unknown, maybe as much as 80 tons/yr.	o Site slopes gently to the north. o Surface water flow is to the north, ultimately discharging to the South Ditch. o Site is underlain by weathered sandy glacial till. o Ground-water flow in the till aquifer is north, possibly discharging to the South Ditch.	o Test Pit Soils Contaminants of Concern: - Aluminum - Copper - Mercury - Zinc - Ammonia - Fluoride - low Level PCB o Leachate Contaminants of Concern: - No contaminant concentrations detected at elevated levels in the leachate samples.	o Ground-water Contaminants of Concern: - No contaminant concentrations detected at levels higher than NYSDEC Water Quality Standards or higher than the background well.
Oily Waste Landfill No Site # Assigned Area 7	Inactive, active from 1979-1984	Landfill with 2 disposal cells. 1 Acre.	Heavy lubricating oily waste and sludges. Approx. 2,000 cu.yds.	o Site sits within topographically high area. o Surface water flow at the site is to the south-southeast, ultimately to the Grasse River through the 001 Outfall or north to the South Ditch. o Site is underlain by weathered sandy glacial till. o Ground-water flow in the till aquifer is north, south, and southeast, discharging to the South Ditch (north) and ultimately to the Grasse River (south) through the 001 Outfall.	o None	o Ground-water Contaminants of Concern: - PCB 1248 - 1,1,1-Trichloroethane - Total Organic Carbon - Total Organic Halogens

(1) Test pit soil/sludge contaminants of concern are those present at levels above normal concentrations in soils.
(2) Ground-water contaminants of concern are those constituents present at concentrations higher than the NYSDEC Water Quality Standards or Guidance Values or higher than background where no standards or guidance values exist.

TABLE 1 (Continued)
SUMMARY OF DISPOSAL SITE DESCRIPTIONS

Area Name	Current Status	Type of Site and Size	Waste Material and Quantity	Environmental Setting	Waste Sampling[1]	Environmental Sampling[2]
Spent Pot-lining Pile "I" #645003	Inactive, active from 1951-1976	Disposal Pile 4 acres.	Spent Pot-liners. 35,000 cu.yd.	o Site is flat. o Surface water flow at the site is to the east to Robinson Creek and the South Ditch. o Site is underlain by silty sand and weathered till. o Ground-water flow is to the southeast to the the South Ditch and Grasse River through the 002 Outfall.	o Leachate Contaminants of Concern: - Aluminum - Ammonia - Cyanide - Fluoride o Leachate is collected for off-site disposal.	o Ground-water Contaminants of Concern: - Benzo(b)fluoranthene - Total Organic Carbon - Oil and Grease - Cyanide
Spent Pot-lining Pile "A" #645001	Inactive, active from 1976-1983	Disposal Pile 1.5 Acres	Spent Pot-liners. 54,600 cu.yd.	o Site rests within a topographically high area. o Surface water drains overland to the north-northwest ultimately to the South Ditch or southeast to the 60 Acre lagoon. o Site is underlain by weathered till. o Ground-water flow in till aquifer is north toward the South Ditch or south-southeast discharging to the 60 Acre lagoon. o Ultimate discharge of leachate is to the South Ditch (north) or 60 Acre Lagoon (south).	o Leachate Contaminants of Concern: - Aluminum - Barium - Chromium (+6) - Copper - Lead - Ammonia - Total Organic Carbon - Chloride - Cyanide - Fluoride - PCB 1248	o Ground-water Contaminants of Concern: - Butylbenzylphthalate - Trimethylsilanol - Ammonia - Total Organic Carbon - Total Organic Halogens - Chloride - Cyanide - Fluoride - Oil and Grease - Sulfate

(1) Test pit soil/sludge contaminants of concern are those present at levels above normal concentrations in soils.
(2) Ground-water contaminants of concern are those constituents present at concentrations higher than the NYSDEC Water Quality Standards or Guidance Values or higher than background where no standards or guidance values exist.

TABLE 1 (Continued)
SUMMARY OF DISPOSAL SITE DESCRIPTIONS

Area Name	Current Status	Type of Site and Size	Waste Material and Quantity	Environmental Setting	Waste Sampling[1]	Environmental Sampling[2]
Primary lagoon #645005C	Active from 1972 - Present	Unlined lagoon 8 Acres	Sludges generated from lime treatment of smelting area scrubber water. Estimated 1 ton/day of sludge deposited in lagoon. Wastewater flow thru lagoon is Approx. 5.5 MGD.	o Site rests within a topographically high area. o Surface water drains overland to the south-southeast, ultimately to 60 Acre lagoon. o Site is underlain by dense sandy glacial till. o Ground-water flow in till aquifer is south-southeast and discharges to the 60 Acre Lagoon.	o Sludge Contaminants of Concern: - Cadmium - Copper - Silver - PAHs - 4,6-dinitro-o-cresol - PCB 1254 - Methylene Chloride - Toluene - Xylene - Ammonia - Cyanide - Fluoride - Sulfate	o Ground-water Contaminants of Concern: - PAHs - PCB 1248 - Ammonia - Total Organic Carbon - Chloride - Cyanide - Fluoride - Total Organic Halogens - Oil and Grease - Sulfate - Dibenzofuran
60 Acre Lagoon #6450050	Active from 1972 - Present	Unlined lagoon 60+ Acres	Process wastewater. Wastewater flow thru the lagoon is approx. 13 MGD.	o Site lies between two ridges and may be discharging point for ground water. o Surface water drains radially to the 60 Acre lagoon. o Site underlain by dense sandy glacial till. o Ground-water flow in till is directed radially toward the 60 Acre Lagoon, ultimately discharging to the Grasse River through the 001 Outfall.	o Sludge Contaminants of Concern: - Arsenic - Copper - Silver - PAH - PCBs - Methylene Chloride - Ammonia - Cyanide - Fluoride	o Ground-water Contaminants of Concern: - Aluminum - PAHs - PCB - Ammonia - Total Organic Carbon - Cyanide - Fluoride - Oil and Grease

(1) Test pit soil/sludge contaminants of concern are those present at levels above normal concentrations in soils.
(2) Ground-water contaminants of concern are those constituents present at concentrations higher than the NYSDEC Water Quality Standards or Guidance Values or higher than background where no standards or guidance values exist.

TABLE 1 (Continued)
SUMMARY OF DISPOSAL SITE DESCRIPTIONS

Area Name	Current Status	Type of Site and Size	Waste Material and Quantity	Environmental Setting	Waste Sampling[1]	Environmental Sampling[2]
Soluble Oil lagoon #645005A	Inactive, active from 1959 to December, 1986.	Unlined lagoon 3 Acres 650'x200'x6' 5 MG Capacity	Soluble oil and water solutions. 300,000 to 500,000 gal/yr.	o Site is located within a nearly flat area. o Surface water is channeled away from the site by drainage ditches to the 60 Acre lagoon and west to the marsh, ultimately to the Grasse River thru the 001 Outfall. o Site is underlain by clayey silt till. o Ground-water flow within the clayey silt till aquifer is west, discharging to the marsh and ultimately to the Grasse River through the 001 Outfall.	o Sludge Contaminants of Concern: - Aluminum - Copper - Arsenic - Silver - Zinc - 2-4-Dimethylphenol - Phenol - PCB 1248 - Tetrachloroethylene - Toluene - Trichloroethylene - Xylenes - Ammonia - Chloride - Cyanide - Fluoride - Sulfate	o Ground-water Contaminants of Concern: - Aluminum - 4-Methylphenol - 2-Methylethylphenol - Benzene - Ammonia - Total Organic Carbon - Oil and Grease - Phenol
Waste Lubricating Oil Lagoon #6450058	Inactive, active from 1969-1980.	Unlined lagoon 1.5 Acres 170'x210'x5'	Halogenated organics, various hydrocarbons, oils and grease. 100,000 gal/yr.	o Site is located within a nearly flat area. o Surface water is channeled away from the site by drainage ditches to the 60 Acre lagoon and west to the marsh, ultimately to the Grasse River thru the 001 Outfall. o Site is underlain by clayey silt till. o Ground-water flow within the clayey silt till aquifer is to the west discharging to the marsh and ultimately to the Grasse River through the 001 Outfall.	o No waste sampling.	o Ground-water Contaminants of Concern: - Aluminum - 4-Methylphenol - 2-Methylethylphenol - Benzene - Ammonia - Total Organic Carbon - Oil and Grease - Phenol

(1) Test pit soil/sludge contaminants of concern are those present at levels above normal concentrations in soils.
(2) Ground-water contaminants of concern are those constituents present at concentrations higher than the NYSDEC Water Quality Standards or Guidance Values or higher than background where no standards or guidance values exist.

5/6

TABLE 1 (Continued) - SUMMARY OF DISPOSAL SITE DESCRIPTIONS

Area Name	Current Status	Type of Site and Size	Waste Material and Quantity	Environmental Setting	Waste Sampling(1)	Environmental Sampling(2)
Sanitary lagoon No Site Number Assigned Area 8	Active from 1962 - Present	Unlined lagoon 18 Acres 20,000,000 Capacity	Sanitary wastewater, storm water, and chlorinated phenol process wastewater, Aprox. 360,000 GPD Wastewater.	o Site is located in a nearly flat area south of a ridge. o Surface water flow is generally toward the marsh and channeled away from the site by drainage ditches, ultimately to the Grasse River through 001 Outfall. o Site is underlain by dense sandy glacial till. o Ground-water flow within the sandy silt aquifer is generally to the south, discharging to the marsh west of the lagoon and utlimately to the Grasse River through the 001 Outfall.	o Sludge Contaminants of Concern: None	o Ground-water Contaminants of Concern: - 4-Methylphenol - Phenol - PAHs - PCB - Benzene - 2-Butanone - Ammonia - Total Organic Carbon - Cyanide - Total Organic Halogens - Oil and Grease - Sulfate
General Refuse Landfill #645002	Active from 1955 - Present	Landfill 17 Acres	Misc. office and cafeteria wastes, baghouse catch, scrap wood, bricks, metal, glass, and allegedly asbestos wastes and dross. 26,000 cu.yd./yr. compacted in-place.	o Site rests on a relatively flat area. o Surface water drains overland and through a series of ditches to the south, southeast and west, ultimately to the Grasse River. o Site is underlain by dense sandy glacial till. o Ground-water flow in the till aquifer is to the southeast, ultimately discharging to the Grasse River through 001 Outfall.	o Test Pit Soil Contaminants of Concern: - Aluminum - Barium - Cadmium - Copper - Mercury - PAHs - PCBs - Ethylbenzene - Xylene o Leachate: - Aluminum - Barium - PCB 1248 - Ammonia - Fluoride	o Ground-water Contaminants of Concern: - PAHs - Naphthalene - 2-Methylnaphthalene - Ammonia - Total Organic Halogens - Oil and Grease - Sulfates
Landfill Annex	Inactive, Period of Operation Unknown	Landfill 5 Acres				

(1) Test pit soil/sludge contaminants of concern are those present at levels above normal concentrations in soils. Sanitary lagoon sludge contaminants of concern are those at levels above normal concentrations in municipal sludge.

(2) Ground-water contaminants of concern are those constituents present at concentrations higher than the NYSDEC Water Quality Standards or Guidance Values or higher than background where no standards or guidance values exist.

TABLE 1 (Continued)
SUMMARY OF DISPOSAL SITE DESCRIPTIONS

Area Name	Current Status	Type of Site and Size	Waste Material and Quantity	Environmental Setting	Waste Sampling[1]	Environmental Sampling[2]
Dennison Cross Road #645004	Inactive, active from 1969-1979.	landfill 3/4 acre	Solvent, degreasing still bottoms, drawing and soluble oil sludges, and wastes containing chlorinated solvents Approx. 10,000 gals. of oily sludges/yr.	o Site rests on a topographically high (ridge) area. o Surface water drains overland to the north, east, and south utlimately to the Grasse River. o Site is underlain by dense sandy glacial till. o Ground-water flow in the till aquifer is to the north and southeast ultimately discharging to the Grasse River. o leachate may discharge to the Grasse River.	o Test Pit Soil Contaminants of of Concern: - Cadmium - Toluene - Trans-1,2-dichloroethane - Xylene - PCB - Fluoride o Leachate: - Barium - Chloroethane - 1,1-Dichloroethane - Fluoride o Leachate Sediments: - 1,1-Dichloroethane - PCBs - Benzene - 2-Butanone	o Ground-water Contaminants of Concern: - Ammonia - Total Organic Carbon - Oil and Grease

(1) Test pit soil/sludge contaminants of concern are those present at levels above normal concentrations in soils.
(2) Ground-water contaminants of concern are those constituents present at concentrations higher than the NYSDEC Water Quality Standards or Guidance Values or higher than background where no standards or guidance values exist.

15.13

- Water samples have been collected from homes in the Dennison Cross Road area by the New York State Department of health (NYSDOH). Inorganic compounds were not detected at levels above the Safe Drinking Water Act Maximum Contaminant Levels (MCLs) (USEPA, 1975), and organic compounds, such as VOCs, PAHs, and PCBs, were not detected in any of the wells (Paller, 1933, Bates, 1986). These results coupled with the ground-water flow patterns from the facility lead to the conclusion that the residents along Dennison Cross Road are not being exposed to contaminants through ingestion of ground-water supplies.

- Ground-water migration between the central and south ridges within the water table aquifer will discharge to the marshy areas in the valley and migrate to the Grasse River via the 001 Outfall.

- Ground water in the water table aquifer flowing northwest from the central ridge, the Fabricating area or west from the Smelting Plant will discharge to the South Ditch and migrate to the Power Canal through the 003 Outfall.

- Ground-water migration in the water table aquifer from the Dennison Cross Road area migrates in a northeasterly direction towards an unnamed tributary to the Grasse River or southeast towards the Grasse River. The potential for contaminant migration is low due to the high clay content of the local soils, low to moderate lateral hydraulic gradients, and low lateral hydraulic conductivities.

- The potential for contaminant migration vertically to the drift and bedrock aquifers is expected to be low due to the presence of dense till and layers of lacustrine clay and marine sediments which separate the aquifers. Based upon this investigation, ground water within the drift and bedrock aquifer has not been impacted by the ALCOA site.

Surface Water and Sediments

Grasse River

- Grasse River. Measureable levels of aluminum (600-1,400 ug/l), phenolic compounds (not detectable-7 ug/l) and fluoride (4.2-6 mg/l) were detected in the surface water at the 001 Outfall (SW-4) in the Grasse River, although no elevated levels of these compounds were detected approximately 4,000 feet downstream at location SW-7, Measureable levels of aluminum (8,530 mg/kg), PAHs (20.9 mg/kg), PCBs (180 mg/kg), fluoride (430 mg/kg), total cyanide (1.6-2.1 mg/kg), benzene (3 ug/kg), and toluene (8 ug/kg) were also detected in the sediments at the 001 Outfall. This sample, however, was collected from behind the outfall weir. The sediments in this location will not be transported downstream. With the exception of aluminum (22,400 mg/kg) and fluoride (430 mg/kg), no elevated levels were detected in the sediments downstream at SED-7. The source of contamination at this outfall is the 60 Acre Lagoon, Sanitary Lagoon, and ground water from the south side of the central ridge which discharges in the marshy areas in the valley prior to transport to the 001 Outfall.

- 004 Outfall. Elevated levels of PAHs (5,130 mg/kg), PCB 1248 (36 mg/kg), aluminum (17,800 mg/kg), and to a lesser extent cadmium (0.88 mg/kg) and copper (106 mg/kg) were detected at the SED-5 location at the 004 Outfall in the Grasse River.

Unnamed Tributary Which Discharges at Massena Center in Grasse River

- Water is discharged at the 002 Outfall (SW-3) from an oil-water separator which eventually flows into the unnamed tributary to the Grasse River. Aluminum (800 ug/l), total cyanide (34-98 ug/l), and PAHs (10,620 mg/kg) are migrating off ALCOA property via the unnamed tributary. PAH contamination (39.8 mg/kg) has been transported by sediment transport as far as location SED-11 in the Grasse River at Massena Center.

Massena Power Canal

- Fluoride (0.8-2 mg/l) and aluminum (200-800 ug/l), are discharging to the Massena Power Canal via the 003 Outfall which drains the Smelting Area and includes contributions from the South Ditch.

Robinson Creek

- Total cyanide (ND-34 ug/l) was the only constituent detected at surface water location (SW-2) in Robinson Creek above NYSDEC Class D Water Quality Standards. However, the water quality standard (22 ug/l) is designed for free cyanide (CN^-, HCN), and is not directly comparable to the measured total cyanide concentration.

St. Lawrence Seaway and River

- Based upon this investigation, the St. Lawrence Seaway and River are not impacted by the ALCOA site. No elevated levels of constituents were detected in downstream samples (SW-10/ SED-10) other than aluminum (< 200-1,000 ug/l) which is also present in upstream samples collected at ALCOA's water intake (100-600 ug/l).

BIOTA ASSESSMENT

The ALCOA Massena site is located near the St. Lawrence Seaway and the Grasse River, which is known for its abundance of fish and wildlife resources. In addition to the rich number of indigenous species, the region is known for its importance as a major flyway for migrating birds. Within the ALCOA Massena site, the 60 Acre Lagoon attracts wildlife and supports various bird, insect, reptile, and mammal life. This area supports a greater diversity and abundance of wildlife than other locations within the site boundaries.

Although the Grasse River and the St. Lawrence Seaway adjacent to the facility, serve as major recreational fisheries, they are not pristine. Existing recreational fisheries are degraded/affected by many sources of industrial pollution throughout the St. Lawrence Seaway and by domestic discharges along the Grasse River. Consequently, industrial pollution of the St. Lawrence River has resulted in health warnings regarding the consumption of fish taken from portions of the St. Lawrence Seaway not affected by the ALCOA Massena Site.

Seven of the eleven disposal sites on the ALCOA facility represent areas of low biological concern. The potential for biological hazard is low because the contaminant exposure levels are at insignificant concentrations and/or the site is closed. These sites include the Spent Potlining Pile "I", the Waste Lubricating Oil Lagoon, the Alleged Asbestos (Dross) Disposal Area, the Oily Waste Landfill, the General Refuse Landfill, the Soluble Oil Lagoon, and the Primary Lagoon. Two sites were considered to be of medium concern (Spent Potlining Pile "A" and Dennison Cross Road Site). Two areas were considered of high concern (60 Acre Lagoon and Sanitary Lagoon) due to the presence of contaminants of concern, the current status of use, and the level of biotic activity at each site.

Many of the site contaminants of biotic concern were associated with the sediments and, hence, the primary exposure pathway is considered to be mediated by the sediments and restricted to the sediment-based flora and fauna. Because of the chemical characteristics of several contaminants and the conditions under which they are present, copper, cyanide, barium and aluminum are believed to have restricted areas of influence and minimal biotic impacts at and adjacent to the Massena site. Other contaminants, such as PAHs, PCBs, flouride, lead, and arsenic pose, by both sediment and water, a greater potential for biotic impacts because of their effects, biomagnification, chemical form, or related factors. Impacts to terrestrial biota could not be fully evaluated because of the lack of available data on the presence of contaminants in upland areas away from the waste disposal areas.

Because of the physical migration of wastes to off-site areas, the unnamed tributary to the Grasse River and the Massena Power Canal also have direct potential for biotic impacts.

15.17

3.4 SOILS

A wide diversity of soils occurs at the ALCOA site. The soils are developed on glacial or lacustrine deposits, or are developing on sediments recently reworked by man. The soils map in Figure 3.2 shows three principal groups of soils whose characteristics are described in Table 3.2. Comparison of Figures 1.2 and 3.2 indicate seven of the eleven disposal areas occur on man-made deposits of slow to very-slow permeability. The Primary Lagoon, Spent Potlining Pile "A", Oily Waste Landfill, and Dennison Cross Road site are underlain by till with moderate to moderately slow permeability. The 60 Acre Lagoon is on lacustrine clays with slow to very slow permeability. Soils are deep to very deep across the ALCOA site, and potential for erosion is low except where land slopes are steep. The soils are well to moderately well drained on the till deposits, but poorly drained in the stream valleys. These characteristics indicate surficial spills or discharges that might occur on the ALCOA site will migrate slowly through the soil zone, and the high clay content of soils should greatly retard the movement of adsorptive contaminants.

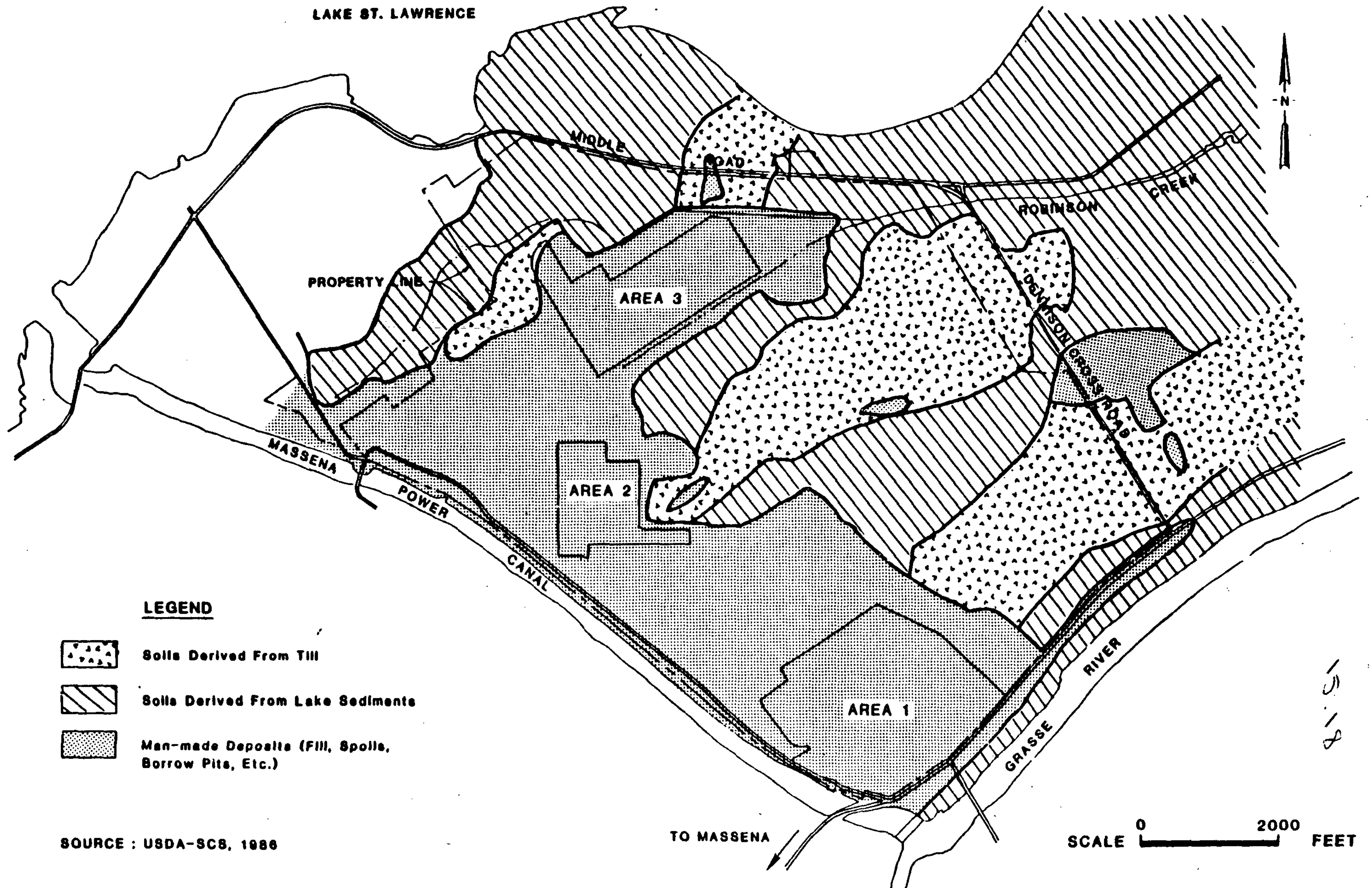
3.5 GEOLOGY

The surficial geology of the Massena area (Figure 3.3) was shaped by glacial action. During the Pleistocene, ice advanced through the region several times; the last two advances are recorded in tills named for the Fort Covington and Malone episodes. Beneath the glacial deposits lie Paleozoic carbonates (predominantly dolomite) and sandstones. Recent alluvium may locally overlie the glacial deposits along streams and rivers. The generalized stratigraphy of the region is shown in Figure 3.4.

The Beekmantown Group is the uppermost bedrock unit beneath the ALCOA site. These rocks are massive dark-gray dolomite containing some beds of limestone, sandstone, and shale. The unit is about 500 feet thick at Massena (Trainer and Salvas, 1962). Test drilling within the ALCOA site indicates these rocks occur at between 80 and 150 feet below land surface. The rocks are rather flat-lying and bedding planes dip approximately 0 to 5 degrees to the north-northwest (Trainer and Salvas, 1962). The Geologic Map of New York (NY Educ. Dept., 1970) indicates the bedrock is part of the southeastern limb of a structural basin. The

GENERALIZED SOILS MAP

ALCOA - Massena, N.Y.



SOURCE : USDA-SCS, 1986

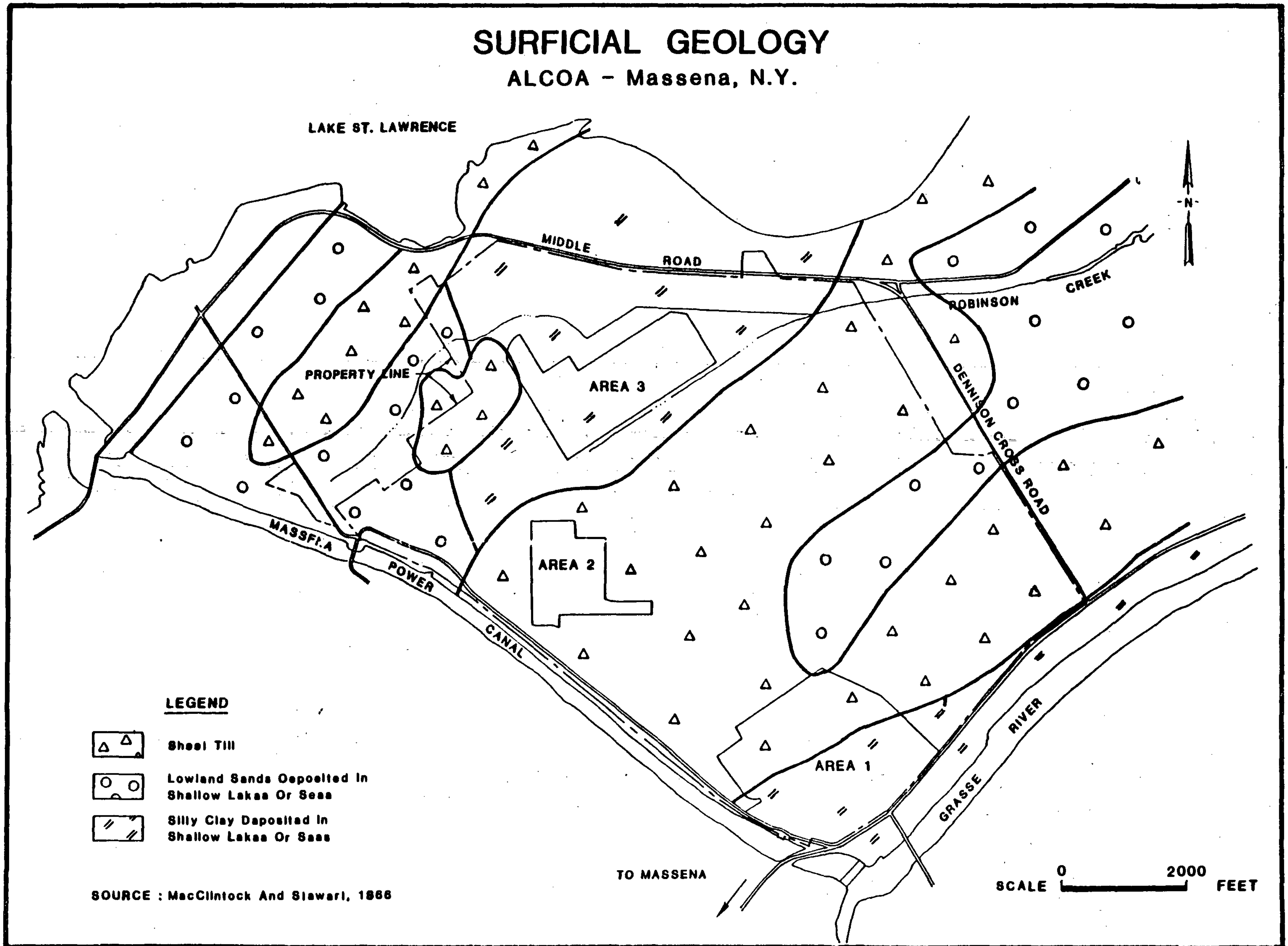
FIGURE 3.2

15.18

TABLE 3.2
GENERAL SOILS CHARACTERISTICS
ALCOA PLANT SITE - MASSENA, NY

Soil Group		Soil Names	Soil Drainage	Soil Permeability	Remarks
I.	Soils Derived From Till	Grenville fine sandy loam	Well	Mod. to Mod. Slow	
		Hogansburg/Grenville fine sandy loam	Well to Mod.	Mod. to Mod. Slow	Stones are common
		Malone Loam	Poorly	Slow to Mod. Slow	Stones are common
		Hogansburg fine sandy loam	Well	Mod. to Mod. Slow	
II.	Soils Derived from Lake Sediments	Kingsbury silty clay loam	Poorly	Slow	
		Covington silty clay loam	Poorly	Slow to V. Slow	
		Adjidaumo Musky silty clay loam	Poorly to V. Poorly	Slow to V. Slow	
		Muskellunge silty clay loam	Poorly		
		Flackville loamy fine sand	Mod. Well	Rapid to Slow	Permeable sand overlies clay
		Elmwood fine sandy loam	Mod. Well	Mod. Rapid to V. Slow	Permeable sand overlies clay
III.	Man-made	Udorthents	Poorly to Well	V. Rapid to V. Slow	Almost all these soils within the ALCOA site are rated slow to very slow permeability

SOURCE: USDA - SCS, 1986.

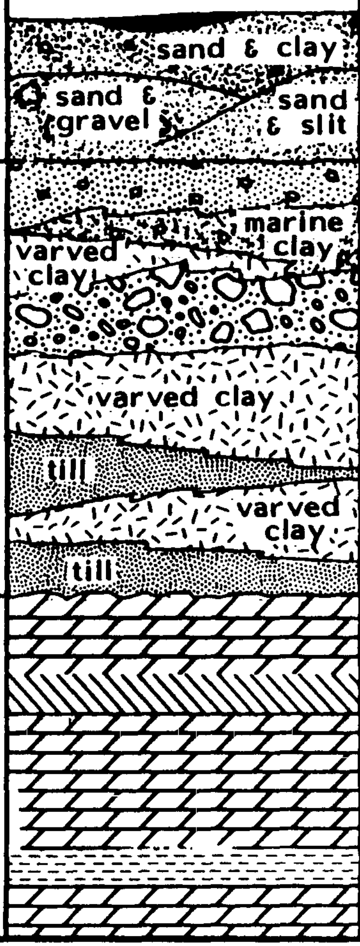


ES ENGINEERING-SCIENCE

FIGURE 3.3

GENERALIZED STRATIGRAPHY

ALCOA - Massena, N.Y.



ACE	LITHOLOGY	UNIT	LOCAL THICKNESS	DESCRIPTION
RECENT	sand & clay; sand & gravel; sand & slit	Alluvium	0-10 ft.	Unconsolidated deposits of gravel, sand, silt and clay along stream channels and in flood plains; peat lenses may occur locally
QUATERNARY Pleistocene	marine clay; varved clay	Fort Covington Drift	20-70 ft.	Unconsolidated glacial and marine deposits, local sequence may include till at base covered by clay, marine clay and marine sand and gravel
	varved clay; till; varved clay; till	Malone Drift	75- 125 ft.	Unconsolidated glacial till and varved clays, local sequence may include very dense till at base covered by clay, moderately compacted till, and clay
PALEOZOIC Ordovician		Beekmantown Group	approx. 500 ft.	Grey to black dolomite containing beds of limestone, sandstone, and shale. Gypsum occurs in veins and as beds up to 5 feet thick.

FIGURE 3.4

15.21

basin is about 100 miles long and 70 miles wide, with the majority of the structure being across the St. Lawrence River in Canada. Trainer and Salvas (1962) report that bedrock faults have been mapped; most faults have been mapped in Canada where the rocks are more extensively exposed. Joints (vertical fractures and cracks) are common and often are solutionally enlarged near the top of bedrock. Trainer and Salvas (1962) noted solutional openings to depths of 50 feet below top of rock at excavations for the nearby Snell and Eisenhower Locks on the St. Lawrence Seaway. These authors also noted that, in quarries, horizontal openings or fractures parallel to bedding are more numerous and wider than joints. Tests of water wells in the Massena area revealed horizontal permeability was much greater than vertical permeability, thus providing additional evidence that horizontal openings in the bedrock are larger and more numerous than vertical openings.

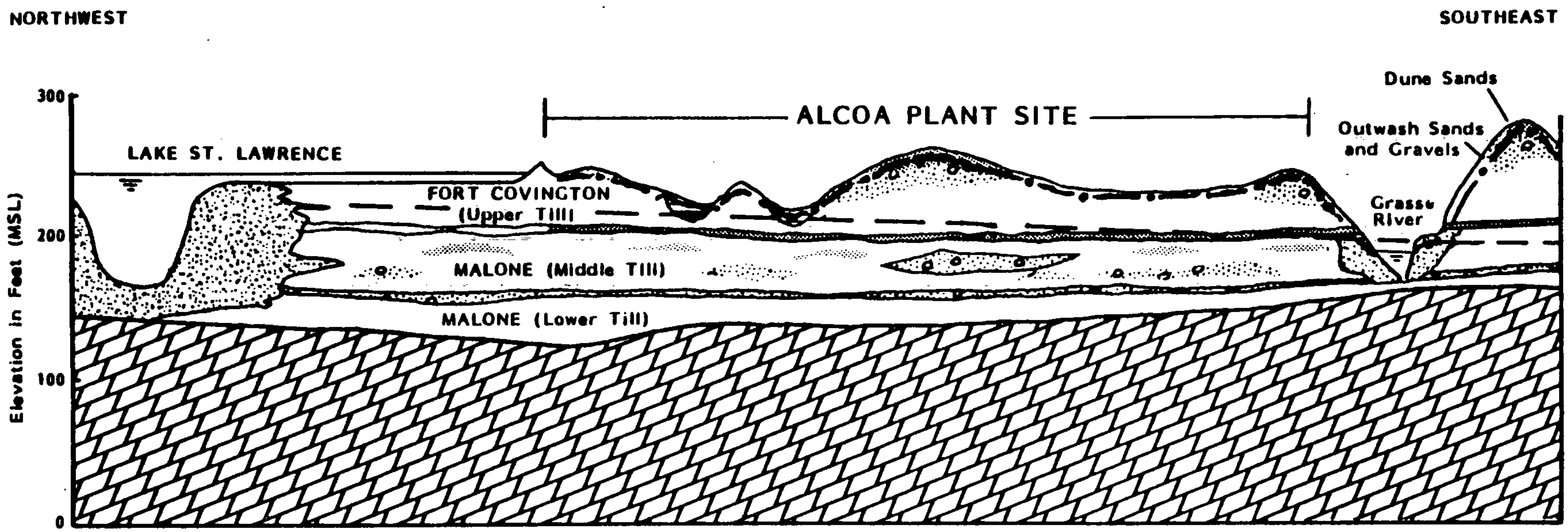
The Pleistocene drift deposits include till, lacustrine (lake) clay and silt units, and marine deposits composed of reworked till. Figure 3.5 depicts typical field relation between glacial deposits and bedrock. The drift deposits are described in detail by Trainer and Salvas (1962) and MacClintock and Stewart (1965); the discussion that follows is a much abbrieviated summary from these sources.

The lower and middle till units in Figure 3.5 are the Malone drift deposits. These deposits of unstratified till and lacustrine clays were placed by glacial advances from the northeast. The lower till is a dense and compact mixture of clay, silt, sand, and stones. The porosity of representative samples is 10 to 20 percent. The middle till is a moderately dense to very dense, mixed deposit of clay, silt, sand, and stones. Although mostly unstratified, the middle till has interbedded sand, silty-sand, gravel and clay (lacustrine) deposits. Above the two till units, varved clays with interbedded sand, silt, and grayel layers mark the recession of the glacier at the end of the Malone episode.

The upper till shown in Figure 3.5 is the Fort Covington drift. These deposits were placed by glacial advances from the northwest and may include reworked till from older advances. This till forms the elongate hills typical of the area, but may be covered in lowlying areas by lacustrine clays and marine deposits. After recession of the

HYDROGEOLOGIC CROSS-SECTION

ALCOA - Massena, N.Y.



LEGEND

- Alluvial Sands and Gravel
- Sands
- Sands and Gravel
- Beekmantown Dolomite
- Glacial Lacustrine Clays
- Potentiometric Surface in Unconsolidated Deposits (Largely unconfined or water table conditions)
- Potentiometric Surface in Bedrock (Largely confined conditions)

SCALE 0 2500 FEET

15.23

FIGURE 3.5

glacier, a shallow sea (Champlain Sea) covered much of the region, eroding the till ridges and washing fine-grained sediments into lower elevations. The marine clay and silt units are between 30 and 60 feet thick in some valleys. Wave-washed deposits of marine sand and gravel may be up to 10 feet thick on hilltops. These marine sediments are stratiform but not compact; typical porosities of the clay units range from 38 to 64 percent, while in the sand units porosities range from 26 to 47 percent.

Recent alluvium includes thin layers of sand, gravel, silt and clay eroded and redeposited by streams. Layers of peat may occur in the alluvium in poorly drained areas.

3.6 HYDROLOGY

Two of the principal pathways for migration of contaminants from the ALCOA site are surface water and ground water.

3.6.1 Surface Water

The ALCOA site is bounded on two sides by major streams: on the southwest by the Massena Power Canal and on the southeast by the Grasse River. Figure 3.1 shows that runoff from ALCOA property into the Power Canal derives from a large area. The central portion of the site, including the Sanitary and 60 Acre lagoons drain to the Grasse River via man-made ditches and sewer lines (001 Outfall). The northern half of the site drains into the South Ditch which flows either east to the 002 Outfall and the Grasse River, or west to the 003 Outfall and the Power Canal. The eastern portion of the site drains to an unnamed creek flowing east toward Massena Center and the Grasse River. Discharge permits have been issued by the State of New York for three ALCOA plant outfalls. Estimated plant discharges are in excess of 12 million gallons per day. Available data cited in reports by Ecological Analysts, Inc. (1983) indicate previous wastewater discharges from the ALCOA site may have released contaminants to the Grasse River. The data suggest that substances spilled or discharged within portions of the plant which drain to the Sanitary or 60 Acre lagoons have the potential to migrate via surface water drainage to the Grasse River through the 001 Outfall.

Local surface water is used for drinking water supplies, recreation and navigation. Lake St. Lawrence and the St. Lawrence Seaway provide an international means of transporting goods into and out of the central part of North America. This water is also used extensively for commercial fisheries, recreational fishing, and boating. The Village of Massena obtains its drinking water supplies from Lake St. Lawrence.

The Grasse River is classified as a Class B stream by the NYSDEC, indicating that it is suitable for fishing and primary contact recreational purposes (Voss, 1987), The Grasse River is considered a highly important, highly productive fishing stream (SUNY ESF, 1972). Major species include: brown bullhead, common sunfish, yellow perch, and largemouth and smallmouth bass. The stretch of the Grasse River in the vicinity of the ALCOA plant is used for recreational purposes, including swimming and fishing.

Robinson Creek is rated as a Class D stream (Voss, 1987), and is also used for recreational fishing purposes. The types of fish present in the Grasse River would also be expected to be found in Robinson Creek. The surface water flow velocity in this creek was measured during the Phase II investigation to be between 24 and 76 gpm.

3.6.2 Ground Water

Subsurface water at the ALCOA facility occurs under both water-table and confined conditions. Ground water occurs under water-table conditions at depths of 10 feet or less beneath all of the ALCOA site; ground water under confined conditions occurs at depths of 50 feet or more beneath most of the site. Ground water occurs at all depths below the zone of saturation, but aquifers - that is, geologic materials that can transmit useable quantities of ground water to wells - do not. Much of the till and lacustrine clay deposits at the ALCOA site are not true aquifers because of extremely low permeability. Commonly, whenever these deposits cover layers of gravel and sand, the overlying deposits act as a confining unit to the more permeable sediments (an aquifer). Although composed of dense interlocking crystals, the dolomite bedrock has sufficient fractures and bedding plane openings to be permeable and locally constitutes an aquifer. According to Trainer and Salvas (1962) a water-table aquifer occurs in the glacial deposits throughout the area, but may be discontinuous locally where low permeability clays occur near land surface. One or more confined aquifers may occur in the middle and lower till (Malone drift) deposits. Beneath the ALCOA site, the bedrock aquifer is also confined by overlying till and clay deposits.

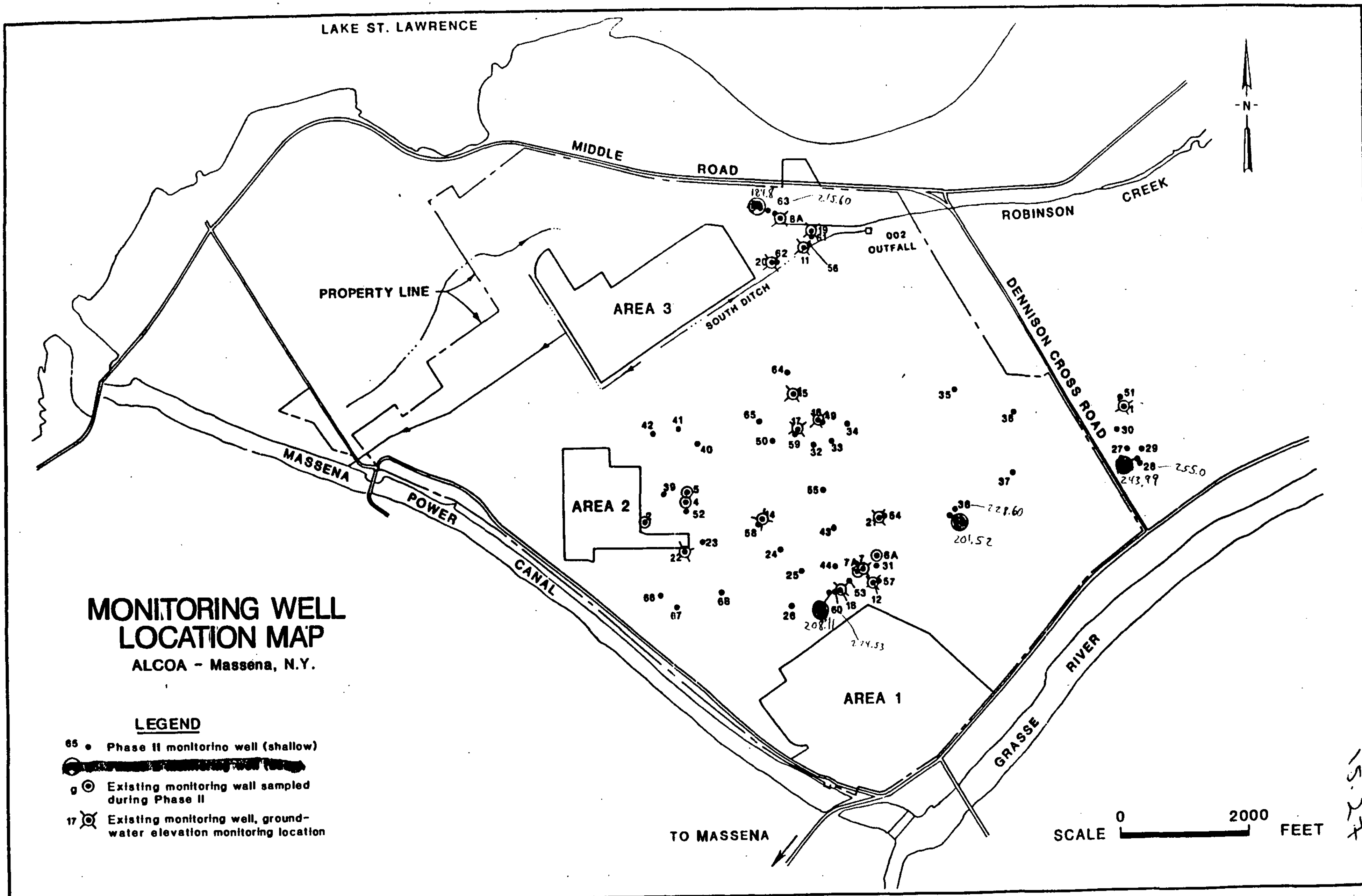
Numerous test borings and wells have been drilled at the site (Figure 3.6). Four test boring logs and 62 well completion records are given in Appendix D. Table 3.3 provides hydrogeologic data for many of the wells shown on Figure 3.6.

All of the shallow wells on-site are open to the water-table and some are open to the water-table aquifer. Water levels from the shallow wells have been plotted on Figure 3.7 to indicate potential directions of flow in the water-table aquifer.

Note that ground-water divides occur in the water-table aquifer along the ridge tops and just east of the 60 Acre Lagoon. Contaminants that reach the water-table aquifer located in the southwestern part of the ALCOA site and/or the south side of the southern ridge will likely migrate slowly toward the Grasse River. Contaminants within the water-table aquifer on the north side of the central ridge should slowly migrate to the South Ditch and ultimately to the Grasse River through the 002 Outfall or to the Power Canal through the 003 Outfall. Contaminants within the water-table aquifer located between the two ridges and east of the 60 Acre Lagoon are expected to migrate toward the east-northeast into the unnamed creek that drains toward Massena Center.

Wells that penetrate the confined aquifers in the drift deposits are sparse in the vicinity of the ALCOA site. A few domestic wells northeast of the site appear to be open to these aquifers, based on well depths reported in Trainer and Salvas (1962). Deep wells 45 and 48, located north of the Spent Potlining Pile "I" site and on the east side of Dennison Cross Road respectively, appear to be in a confined aquifer within the drift deposits. A water level map for the drift aquifers cannot be made with the available data, however, comparison of water levels in wells 45 and 48 with nearby water-table wells indicate the deeper confined aquifers are locally recharged by the water-table aquifer. Trainer and Salvas (1962) similarly concluded this and suggest that discharge from the drift aquifers occurs both by lateral flow to seeps along valley margins and by downward flow into the aquifer.

FIGURE 3.6



MONITORING WELL LOCATION MAP

ALCOA - Massena, N.Y.

LEGEND

65 • Phase II monitoring well (shallow)

[redacted]

9 ◉ Existing monitoring well sampled during Phase II

17 ⊗ Existing monitoring well, ground-water elevation monitoring location

15.27

ES ENGINEERING-SCIENCE

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TABLE 3.3
DATA FOR MONITORING WELLS
ALCOA PLANT SITE - MASSENA, NY

Well Number	Elevation Land Surface (ft AMSL)	Elevation Measuring Point[1] (ft AMSL)	Well Depth (ft BLS)	Screen Interval (ft BLS)	Hydraulic Conductivity[2] (ft/day)	Water Level May 30, 1986 (ft AMSL)
2	262.24	266.41	20.0	15.0-20.0	---	259.23
4	276.33	279.46	28.0	21.5-27.5	---	266.95
5	269.23	272.49	13.5	6.5-11.5	---	260.88
6A	227.21	229.99	8.0	6.0- 8.0	---	224.99
7A	229.11	232.12	12.0	8.0-12.0	---	224.85
23	239.90	242.65	18.0	8.0-18.0	$1.6x10^{0}$	230.13
24	227.50	230.43	18.0	8.0-18.0	$3.4x10^{-1}$	221.48
25	226.79	230.03	18.0	8.0-18.0	$2.1x10^{-1}$	219.04
26	227.91	231.87	15.0	5.0-15.0	$4.5x10^{-1}$	221.34
27	260.92	264.53	22.0	12.0-22.0	$3.4x10^{-1}$	259.74
28	258.89	261.99	22.0	12.0-22.0	$5.4x10^{-2}$	255.00
29	261.20	264.07	20.0	10.0-20.0	$7.9x10^{-1}$	258.57
30	263.00	265.98	14.5	4.5-14.5	$1.0x10^{-1}$	260.47
31	227.16	230.51	14.0	4.0-14.0	$2.6x10^{0}$	225.37
32	261.60	265.14	14.0	4.0-14.0	$2.8x10^{0}$	255.19
33	260.58	263.96	19.0	9.0-19.0	---	252.87 (3)
34	262.19	265.58	16.0	6.0-16.0	$2.8x10^{1}$	249.36
35	245.70	249.17	17.5	7.5-17.5	$1.1x10^{-1}$	241.55
36	231.94	235.53	21.0	11.0-21.0	$3.4x10^{-1}$	228.60
37	236.05	238.85	18.0	8.0-18.0	$4.0x10^{-2}$	233.47
38	227.61	231.13	14.0	4.0-14.0	$6.8x10^{-2}$	228.74
39	273.94	277.41	16.0	6.0-16.0	$7.4x10^{-2}$	268.04
40	241.14	244.49	14.0	4.0-14.0	$7.9x10^{-1}$	239.86
41	235.81	239.76	14.5	4.5-14.5	$4.5x10^{-1}$	233.65

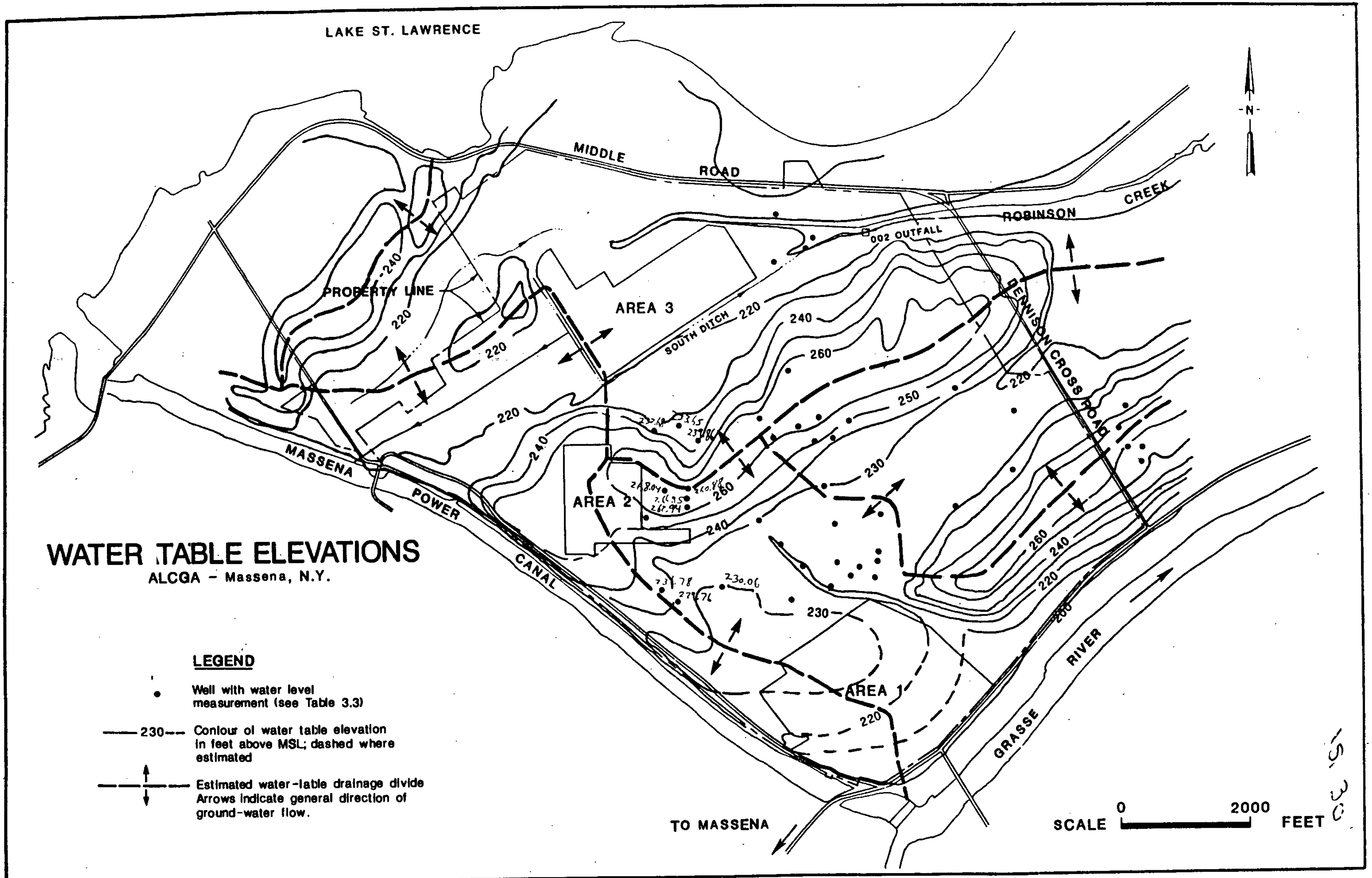
AMSL Above Mean Sea Level
BLS Below Land Surface
(1) Measuring point was top of outside steel (protector) casing.
(2) Data from slug tests performed by O'Brien and Gere, Inc., May, 1986.
(3) Well screen may be plugged; value may not be representative of water table elevation.

\5.29

TABLE 3.3 (Continued)

Well Number	Elevation Land Surface (ft AMSL)	Elevation Measuring Point(1) (ft AMSL)	Well Depth (ft BLS)	Screen Interval (ft BLS)	Hydraulic Conductivity(2) (ft/day)	Water Level May 30, 1986 (ft AMSL)
42	249.11	252.56	24.5	14.5-24.5	$6.0x10^{-1}$	232.68
43	228.74	232.42	14.0	4.0-14.0	$1.2x10^{-1}$	224.08
44	228.99	231.81	16.0	6.0-16.0	$1.8x10^{0}$	224.69
45D	218.00	220.47	90.0	70.0-90.0	$8.2x10^{-2}$	134.80
46D	228.89	231.19	84.5	64.5-84.5	$6.0x10^{-2}$	208.11
47D	231.49	234.18	110.0	90.0-110.0	$1.5x10^{-1}$	201.52
48D	258.86	261.69	103.0	78.0-103.0	$3.4x10^{-3}$	243.99
49	267.01	270.78	14.0	4.0-14.0	$3.4x10^{-1}$	264.85
50	262.88	266.58	14.0	4.0-14.0	$1.2x10^{-1}$	262.86
51	250.53	253.77	15.5	5.5-15.5	$1.9x10^{-1}$	248.47
52	270.47	274.00	15.0	5.0-15.0	$2.2x10^{0}$	262.94
53	228.95	232.70	14.0	4.0-14.0	$8.2x10^{-2}$	225.59
54	227.64	231.37	13.5	3.5-13.5	$3.1x10^{0}$	226.06
55	231.49	235.27	14.0	4.0-14.0	$1.5x10^{-1}$	230.27
56	216.61	220.07	14.5	4.5-14.5	$7.1x10^{0}$	207.97
57	229.88	232.36	14.0	4.0-14.0	$1.2x10^{-1}$	225.36
58	237.55	241.22	14.5	4.5-14.5	$8.8x10^{0}$	232.43
59	266.02	269.61	14.5	4.5-14.5	$7.4x10^{-2}$	264.09
60	229.18	232.67	14.0	4.0-14.0	$5.1x10^{0}$	224.53
61	216.11	219.65	14.5	4.5-14.5	$2.8x10^{1}$	208.59
62	217.22	220.42	14.5	4.5-14.5	$7.1x10^{0}$	212.19
63	218.38	221.44	19.5	9.5-19.5	$1.1x10^{-1}$	215.60
64	275.13	278.30	14.5	4.5-14.5	$2.7x10^{0}$	268.00
65	266.57	270.12	16.0	6.0-16.0	$7.4x10^{-2}$	265.07
66	236.75	239.67	15.0	5.0-15.0	$2.4x10^{0}$	231.78
67	231.97	235.37	15.0	5.0-15.0	$1.0x10^{-2}$	229.76
68	232.73	236.17	15.0	5.0-15.0	$4.3x10^{-3}$	230.06

(1) Measuring point was top of outside steel (protector) casing.
(2) Data from slug tests performed by O'Brien and Gere, Inc., May, 1986.
(3) Well screen may be plugged; value may not be representative of water table elevation.
D = Deep Well.


LAKE ST. LAWRENCE
MIDDLE ROAD
ROBINSON CREEK
002 OUTFALL
PROPERTY LINE
AREA 3
SOUTH DITCH
DENNISON CROSS ROAD
AREA 2
AREA 1
MASSENA POWER CANAL
GRASSE RIVER
TO MASSENA
N
SCALE 0 2000 FEET
220
240
260
250
230
WATER TABLE ELEVATIONS
ALCOA - Massena, N.Y.
LEGEND
Well with water level measurement (see Table 3.3)
230 Contour of water table elevation in feet above MSL; dashed where estimated
Estimated water-table drainage divide Arrows indicate general direction of ground-water flow.

Only a few wells are open to the bedrock and local water level data for the bedrock aquifer are sparse (Wells 46, 47, Table 3.3). Trainer and Salvas (1962, Table 5) report transmissivity measurements for 23 bedrock wells in the Massena area; average thickness of bedrock penetrated was about 69 feet and average hydraulic conductivity computed from individual transmissivites was 31 ft/day.

Historical measurements and hydrologic reasoning suggest that water levels in the bedrock aquifer should be higher near Lake St. Lawrence and lower near the Grasse River. Available data have been used to estimate that water levels in the bedrock aquifer occur at approximately 215 feet MSL beneath the northern end of the ALCOA site and at approximately 195 feet below the Grasse River. Ground-water flow in the bedrock aquifer beneath all parts of the site is expected to be toward the Grasse River.

Comparison of water levels in Wells 46 and 47 with nearby water-table wells suggest the bedrock aquifer receives recharge from overlying deposits. This observation is consistent with previous studies in the area. Although testing of aquifer properties is limited, available data indicate horizontal hydraulic conductance in the bedrock aquifer is much greater than vertical, conductance. This means that the aquifer may transmit more water laterally under unit head differences than might be transmitted vertically.

Locally, ground water is used for domestic purposes in areas outside the distribution limits of the Village of Massena. Residents in the area bounded by the St. Lawrence Seaway to the northwest, Donaghue Road to the east, the Grasse River to the southeast, and the Massena Power Canal to the southwest use ground-water wells for their water supplies; available information on these wells is summarized in Table 3.4. Most of the wells in the vicinity of the ALCOA site tap aquifers within the till, although a few wells are in the bedrock aquifer. No industrial wells are known to occur within a three-mile radius of the center of the ALCOA site.

Natural ground-water quality is good. Dissolved solids in water from the till aquifers tends to be less than 500 mg/l, but the water may be hard (Trainer and Salvas, 1962), The dissolved solids and chloride content generally increase with depth in the bedrock aquifer due to

15.32

TABLE 3.4
GROUND-WATER USERS IN THE ALCOA VICINITY(1)

Name	Address	Type of Well	Depth of Well (ft)	Source
Lewis	St. Lawrence River Road	Drilled	140	(2)
Copeland	St. Lawrence River Road	Drilled	135	(2)
Adam's View Restaurant	St. Lawrence River Road	Drilled	175	(4)
Miller	St. Lawrence River Road	Drilled	180	(5)
Wronowicz	Dennison Cross Road	Dug	Unknown	(2)
Durant	Dennison Cross Road	Drilled	120	(3)
Vatter	Dennison Cross Road	Drilled	150-160	(2)
Dishaw	Dennison Cross Road	Drilled	168	(3)
Furnace	Dennison Cross Road	Drilled	125	(3)
Konkowski	Dennison Cross Road	Drilled	180-200	(3)
Rider	Dennison Cross Road	Drilled	120	(2)
Conto	Dennison Cross Road	Drilled	95	(3)
Deleel	Dennison Cross Road	Drilled	Unknown	(2)
O'Donnell	Dennison Cross Road	Drilled	100	(2)
Martin, B.	Dennison Cross Rd.&Rt.131	Dug	Unknown	(3)
Martin, D.	Dennison Cross Rd.&Rt.131	Dug	Unknown	(2)
Vice	Rt. 131	Dug	40-50	(2)
Terry	Horton Road	Drilled	80-100	(2)
Pellietier	Horton Road	Drilled	119	(2)
Downey	Horton Road	Dug	14	(2)
Massena Park Inn	Snell Lock Road	Drilled	> 100	(2)
Carton	Massena Center	Dug	35	(2)
LeBlanc	Massena Center	Drilled	Unknown	(2)
Corbin	Massena Center	Drilled	Unknown	(2)
Smith, G.	Massena Center	Drilled	23	(2)
Smith, L.	Massena Center	Dug	22	(2)
Johnson	Massena Center	Dug	25	(2)
Rickard	N. Grasse River Road	Drilled	199	(2)
Page (Business)	N. Grasse River Road	Dug	30	(2)

(1) 80 wells have been identified in area (O'Brien & Gere, 1984). Only wells with some information available on the type or depth are included herein.

(2) Data obtained from home owner.

(3) Data obtained from NYSDOH (Power, 1986).

(4) Data obtained from well driller (Nash, 1986).

(5) Data obtained from well driller (Harwood, 1986).

ground water dissolution of mineral water and the mixing of fresh ground water with salty water derived from the Champlain Sea. The ground water is a calcium-magnesium bicarbonate water which reflects the soluble nature of the dolomite bedrock. Upward migration of brines along fault zones may be the cause of localized increases in mineralization. Sulfur springs were noted upstream of ALCOA in the Grasse River (Trainer and Salvas, 1962).

Analysis of water samples from test wells at the site indicate the water-table aquifer contains low levels of contaminants that may have migrated from nearby unlined lagoons or disposal areas. Once contaminants reach the water-table aquifer, there is a potential to migrate both laterally and downward to deeper aquifers. Ground-water movement within the water-table aquifers is slow and migration of highly absorptive contaminants may be exceedingly slow due to the high clay content of the drift deposits. Directions and rates of contaminant movement within deeper confined aquifers is difficult to estimate with available data. Lateral rather than vertical migration is probably predominant, because horizontal permeabilities are much higher than vertical permeability within the drift and bedrock units.